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The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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Machine Tools and Castings

The Fifth Machine Tool and Engineering Exhibition, which opens at Olympia to-day, presents the first opportunity for six years of obtaining a comprehensive picture of the outstanding developments in the design and application of machine tools which are such characteristic features of modern production engineering. Apart from the great strides which have been made in the refinement of design in these years, it is rather astonishing to recollect that at the last similar exhibition in 1928 the cemented carbide cutting alloys had not obtained a footing as a practical proposition in influencing machining speeds. The situation to-day is very much altered, therefore, on the score of both precision and speed. The accuracy with which the most up-to-date machine tools fulfil their duties is little short of marvellous, even to those who are daily associated with their operation, but this precision and the ever-increasing speeds at which machining is being carried out are apt to react somewhat unfairly upon the demands which the engineer user of castings makes upon the foundry.

Thinking of his limits in terms of tenths of a thousandth of an inch, the engineer is becoming prone to ask the impossible of the foundry in respect of machining allowances, but it should be impressed upon him that, despite the astonishing accuracy of modern machine tools and the fine limits necessary for quantity production work, the foundryman is still confined to his sand moulds to give material expression to the designs of the engineer. As it is, machining allowances have in many cases been reduced to an extent which would have been unbelievable to the foundryman of twenty or less years ago, but even allowing for developments in moulding equipment and the use of oil-sand cores the limitations of the sand mould, whether green or dry, are still the governing factors in the production of castings which shall clean up satisfactorily and yet require the removal of the least possible amount of metal.

The recent tendency to replace grinding by high-speed milling, for example, has focussed attention upon machining allowances to a still greater extent, whilst having the effect of making the presence of a hard skin more apparent. The two factors are, of course, interconnected. The less metal there is to be removed, the more pronounced will be the effect of the outer surface, contaminated with sand and oxide and almost invariably chilled to a slight extent, since the tool will not be able to work on the softer metal below the surface. The cemented carbide tools have, of course, simplified matters considerably as far as speed is concerned, where the amount of metal to be removed is not excessive, but there is still much confusion of thought on the question of dimensional accuracy in the two spheres of machine-shop practice and foundry work. The foundry is intent on keeping pace with the developments in production engineering, and is quite capable of doing so, but inordinate demands upon its skill in producing castings of unnecessarily high dimensional accuracy will not further the cause of efficiency and economy. Rather will a policy of active co-operation between the production engineer and the foundry in deciding upon locating points and machining allowances lead to the most satisfactory utilisation of the resources of modern machine tools.

The Limits of Technical Education

In his address to the British Cast Iron Research Association, Major F. A. Freeth quoted with approval some remarks from a recent lecture by Sir Josiah Stamp having the above title. Speaking as a large employer of labour, Sir Josiah's words have special authority, which is enhanced by his reputation as an economist and publicist. Briefly summarised, he praised technical education, and would do everything possible to encourage it to the utmost limit to which it is capable of being taken, and said that it represents in many fields a great improvement on the conventional method of learning a job on the spot. At the same time, he very clearly indicated the limitation of technical education, and this is one which every industrialist will endorse. He said in effect that he did not know of a practical railwayman (and he speaks as President of the L.M.S.), who would promote men in industry on a basis of excellence in attending classes and passing examinations, or who would regard such excellence as deserving of special consideration with respect to salary or promotion. It is well recognised that those who are engaged in industry are constantly using and developing faculties which in the nature of things cannot be called into play or used in a school, and it is the power to exercise these faculties which differentiate one man in industry from others less deserving. We have all met the man who by some gift of memory or interest in academic argument is able to do very well in examinations but who is helpless and hopeless in a task calling for initiative, drive, responsibility and strength of character, including that power of judgment in taking quick decisions which

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stand the test of time. On the other hand, we have all met the man who has done well in industry in the teeth of almost every handicap with respect to lack of technical knowledge. So we have to recognise that if a man can mark himself out for industrial promotion, his technical education and training will be an advantage, but indirect rather than direct, and those responsible for technical education must face the fact and not imply any direct connection between success at school and success in life. It is to their credit that they do not, but on the other hand there is yet little tendency to modify educational courses and examinations to make them tests of capacity rather than knowledge.

Answers to Foundry Queries

CYLINDER LINERS ("S.G.D.G." F.T.J., Nov. 1)

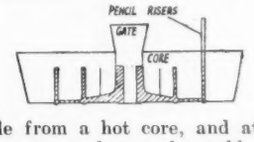
Taking it for granted that a suitable mixture has been evolved for this type of casting, these liners may be quite satisfactorily under-run with a runner entering the mould as nearly as possible tangentially. The riser should be simply obtained by thickening the upper part of the cylinder to about 1½ in., and making this part about 2 in. longer than the liner required finally. The runner, provided with a suitable runner bush, should be not less than 1 in. in diameter.

Cylinders of this type are usually cast in the vertical position, and this method simply means that all of the mould, with the exception of the core print for the cylinder, is in the cope, and renders the moulding operations comparatively simple. The scrap return with moulds made on this principal is less than usual, and the moulds may be made at a slightly greater rate.

Without going into the details of the method it may be said that this is contrary to most, but the writer has seen many instances where the adherence to the ordinary method of top-pouring has persistently caused porosity, and, in view of the pressure test, this alternative way is more suitable. C. D. A.

UNMACHINABLE IMPELLER CASTING

In your edition of October 18 I note a foundry query regarding chilled impeller vanes. This is a position that arises very frequently on designs of this description, and I find the only way to overcome the difficulty is to make a block pattern with vanes, etc., formed in a core box as per enclosed sketch. This enables the casting



to be made from a hot core, and at the same time, of course, a dry sand mould. It is not necessary for the mould to be hot, and, by adopting a method such as this, production is not held up, as the cores can be withdrawn from the stove and closed just prior to casting. You will also note that the casting is gated at the centre, and pencil risers are taken at the tips of each blade. "PREVIOUSLY TROUBLED."

International Foundry Trades' Exhibition

The next foundry trade exhibition is to be held next September at Olympia, in conjunction with the Shipping, Machinery and Enginering Exhibition, which is organised by Messrs. J. W. Bridges & Sons, Limited, Grand Buildings, Trafalgar Square, W.C.2. The space to be occupied is the quadrant at the opposite end to the main entrance. Space allocations are now being made.

District Presidents.—No. 9

SCOTTISH BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN

Mr. Herbert Hurst, the newly-elected President of the Scottish Branch of the Institute of British Foundrymen, is a native of Oldham, Lancs. He received his early education in that town and served his apprenticeship with Messrs. Platt Bros. & Company, Limited, Oldham. While serving his apprenticeship and during his early years as a journeyman he attended classes and obtained first-class certificates in patternmaking, moulding and steam engineering at the Oldham Technical School. After a few years he started in business for himself as a patternmaker and brass-

MR. HERBERT HURST.

founder in Coventry. Three years later he was appointed foundry manager to Messrs. Thwaites Bros., Limited, Bradford, where he remained the first two years of the war until he joined the Aeronautical Inspection Directorate. At the end of the war he became manager to Messrs. J. Carlisle & Company, Limited, Manchester, and later foundry manager with Messrs. Brookes & Docks, Limited, Manchester. In 1924 Mr. Hurst was appointed foundry manager to Messrs. Thos. White & Sons, Limited, Laighpark Works, Paisley, where he remained six years. In 1930 he was appointed foundry manager to Messrs. James Howden & Company, Limited, Scotland Street, Glasgow, and a few months later he was put in charge of the patternmaking department in addition. Mr. Hurst, during his time at Howdens, has been associated with the development and working of the Brackelsberg furnace, the British rights of which are held by the firm.

Testing Methods for Moulding Sand

A knowledge of the constituent particles of a moulding sand is of great importance in making satisfactory castings. Recent work in the experimental foundry of the U.S. Bureau of Standards has shown that a modification of the sedimentation method can be applied readily for testing these sands. By means of a transfer pipette, a sample is taken of a water suspension of the moulding sand which has been allowed to settle for a definite period of time which depends upon the size separation desired. The weight of this sample after being evaporated to dryness, affords a basis for calculating, on a percentage basis, the size distribution of that portion of the original material which is too fine to be classified by sieve analysis.—"Steel."

Copper Takes a Jump

BY "ONLOOKER."

It is more or less a commonplace that, on any decline in valves, things always look worse at the bottom, and this has certainly proved to be the case with copper, which, after falling below £26 for standard, executed a sudden *volte-face* and climbed rapidly to £29 10s. three months before the reaction came. This setback has, as a matter of fact, been a good deal more severe than was anticipated, and at the time of writing the quotation has gone below £28, and looks as if it may go lower before the pendulum begins to swing once more in the opposite direction. During this period of changing values the weekly turnover has been very heavy, running up to about 16,000 tons, compared to a normal 3,000 to 4,000 tons when quieter conditions prevail.

Although consumers have perforce come in and bought pretty freely, the short-lived improvement in values was caused by speculative purchases on the warrant market, and this movement seems to have started as the result of an announcement by Kennecott that their output would be cut by a further 20 per cent., an example followed by Phelps Dodge and Calumet and Hecla, but at the time of writing no word has come from Anaconda; nor have any of the smaller producers made any statement. This initial step by the American producers is expected, however, to be only a prelude to a more extensive programme of curtailment by copper mines all over the world, and it is really this larger aspect of the case which has encouraged such enthusiastic support of the market. As only too frequently happens, however, the buying came to a sudden stop, profit taking supervened, and with professional operators unwilling to buy at the higher levels, the quotation crumbled rapidly. Built on the unstable basis of conjecture and over-optimistic expectations, the bull market collapsed as soon as the daily prop of new speculative buying was withdrawn.

That drastic remedies are necessary if the price of copper is to be kept from falling to a level even lower than that ruling early in October, cannot be doubted, for the situation in America is far from good, and it may be taken for granted that little or no expansion in the rate of consumption in other parts of the world is to be expected. Actually, the U.S.A. primary producers have agreed to stand aside again in favour of the Custom smelters, and during November, therefore, these secondary producers are to have a clear field for their sales. That this should be necessary is an indication that consumption is not picking up across the Atlantic, and probably the October figure will show little or no improvement on the September tonnage of 22,000 short tons. In this country copper usage is maintained at a very satisfactory figure, but on the Continent conditions are not so good, although Germany is probably taking more metal than has been estimated. If anything, the tendency during the next few months may well be rather retrograde, and since production is at present outstripping consumption, it is necessary that the two should at least be brought into alignment.

That the rally in copper was so short-lived is a clear indication of the weakness underlying the whole situation, and it is perhaps as well that the bubble was pricked early, for, had the rise gone on, we should not have heard much more about curtailment. As it is, the low-cost mines know exactly what they have to expect, and without a doubt the alternative to some plan for reducing production is a considerably lower price level, possibly about £20 for standard in London. Perhaps copper interests are prepared to face this; if so, it is a poor outlook for their shareholders!

International Foundry Congress

From Our Special Correspondent

Detroit, Tuesday, October 16.

We have had a crowded five days since our arrival in New York on Thursday morning. Owing to the stormy crossing we arrived in New York Harbour about midnight on Wednesday, October 10, instead of in the morning of that day, and as we arrived too late in the day for the Immigration and Customs officials to attend to us (we were quite willing to forgo this pleasure), we remained all night a few miles from the City and docked about 8.30 on the Thursday morning.

Immediately on stepping ashore we were met by Mr. Dan Avey, President-Elect of the American Foundrymen's Association. When the Customs formalities were over, Mr. Avey hustled us into motor coaches, and in an endeavour to make up some of the lost time, we were given a three hours' rapid run which embraced nearly every part of Manhattan Island. By clever planning we were able to obtain a glimpse of almost every aspect of this extraordinary city in a very short time. Fifth Avenue, Broadway, Central Park, Riverside Drive, Harlem, the Bowery, the Jewish Quarter and Chinatown, all were included in this breathless hustle. Our guide (not Mr. Avey but a tourist agent's guide) allowed us to miss nothing. Even the Funeral Parlour, which carried out the arrangements for the funeral of Rudolph Valentino, was included, but as Queen Victoria was said to have remarked, "we were not amused."

After lunch at the Hotel Taft and registrations, receipt of badges and programmes, etc., the rest of the day was spent in individual sightseeing, Radio City and the Empire State Building claiming most attention.

After dinner we departed from New York by night train for Buffalo, arriving at that city about 7.0 a.m. on the morning of Friday, October 12. Four sleeping (Pullman) cars and a luggage van were required to carry us and our belongings, and we found that the other passengers on the train were under the impression that we were the Metropolitan Opera Company on tour. We hadn't the heart to disillusion them.

Our progress from the station at Buffalo to the Hotel Statler was triumphal. Speed "cops" on motor cycles rode before and alongside and cleared the traffic. We disregarded traffic signals, and all traffic was waved out of the way by our escort. At the Hotel Statler we were met by Mr. P. J. Krantz, of the Buffalo Foundry & Machine Company, Mrs. Krantz and members of the Buffalo committee, and after breakfast the delegates visited the works of the Worthington Pump & Machinery Corporation, whilst the ladies were conducted round the city. It is proposed to give a brief description of this plant and also descriptions of other works which were visited in subsequent articles, because the very full and strenuous programme which we are carrying out does not give sufficient leisure to prepare detailed descriptions at present.

BUFFALO

Many of the foundrymen of Buffalo joined us at lunch and we were welcomed on behalf of the civic and commercial official bodies by the President of the Chamber of Commerce, Mr. J. Leonard, President of the Belgian Foundrymen's Association replying for the guests, his speech being interpreted by Mr. Delport. Mr. Avey also voiced the greetings of the American Foundrymen's Association. Next came one of the attractions of the tour, the trip to Niagara Falls. This was followed by a visit to the works of the Carborundum Corporation, one of the many industrial establishments which draw their power from the falls and which help to make up the new extensive American City of Niagara Falls. Dinner was served at the Niagara Hotel and was presided over by Mr. Bowman, of the Carborundum Corporation, whose hospitality provided the aperitifs. The thanks of the delegation to the Corporation was voiced by Mr. T. Makemson and Mr. Vicaire, of France. Being Columbus Day, a special toast was drunk in honour of the Italian party. A return visit was paid to the Falls after dark in order to view the wonderful sight of the coloured searchlight illuminations. It is impossible to describe the beauty of this striking spectacle, one of the most memorable of the trip. Each visit to the Falls involved the passage to the Canadian side and the return, with Customs and passport formalities at each end of the bridge each time, eight examinations in all. Prohibition seems to have been responsible for some of these restrictions and it is hard to remove them.

After the second visit to the Falls the coaches returned to Buffalo, where we joined the night train to Chicago, arriving in that city about 8.30 on Saturday morning, October 13.

CHICAGO

One hundred years ago—in 1833 to be exact—Chicago received a Charter of Incorporation. At that time it was a small cluster of huts built around a fort. To-day Greater Chicago has a population of about three millions. Although it is an industrial city and one of the world's biggest railway centres, yet when viewed from the lake front it is surely one of the most beautiful cities in the world. Parks, gardens, boulevards, large hotels and apartment houses and the homes of the wealthy (there are still many of them left) line the shore of Lake Michigan for many miles.

An hour after arrival we commenced a tour of the city and obtained a general impression of its beauty, of its traffic and of its trade. (Chicago is one of the many cities which possesses the busiest street in the world.) After lunch, which was served at the great department store of Marshall Field & Company, we paid our first visit to the World's Fair, Century of Progress Exposition.

The World's Fair was opened in 1933 and celebrated the one hundredth anniversary of Chicago Charter. So successful was the exhibition that it was reopened in 1934 after extensive alterations. We are quite prepared to accept the assurance that this gigantic show is the biggest in the world. Surely nothing so colossal has ever been attempted before. Three and a-half miles along the shores of the lake are covered by the exhibits, which include almost every activity to which man has devoted his attention during the last one hundred years.

On Saturday evening, October 13, the whole of the party was entertained to dinner in the Trustees' Lounge of the Fair by the President of the Fair, Mr. Rufus M. Dawes, a brother of General Dawes, and by the Fair authorities. Addresses of welcome were given by Mr. R. C. Ross, of the Chicago Chamber of Commerce, and Mr. Joshua d'Exposito, the distinguished constructional engineer who designed the Sky Ride at the Fair and who was also responsible for the building of Union Station, Chicago, and other important buildings. Dr. Guido Vanzetti replied on behalf of the visitors, and, referring to the large number of ladies present, expressed the opinion that a gathering of men and women formed the most perfect of all alloys.

At this dinner we met many Chicago foundrymen and their ladies, and also met many old friends well known to British foundrymen, including Mr. R. S. McPherran, of the Allis Chalmers Company, and Mr. W. J. Grede, of Liberty Foundry, Milwaukee, and Mrs. Grede.

Sunday was devoted to detailed individual inspection of the Fair, and there were more visits to works on Monday. One party of energetic people spent Monday in a "side trip" to Milwaukee, 91 miles from Chicago, and received a royal welcome from the foundrymen of that city, who hustled us into their automobiles and crammed as many works visits into the day as possible. The whole of the party were the guests of the Allis Chalmers Company at lunch, and were welcomed by the President of the company, Mr. Leonard, replying on behalf of the visitors. There was another round of visits after lunch, a dash to the station, departure amid the cheers of our Milwaukee friends, and then we returned to Chicago. Later in the evening, the whole party of overseas delegates left for Detroit, arriving in the City of Automobiles about 8 a.m. on Tuesday morning. This American hospitality is overwhelming. Our friends are anxious that we shall see everything, and we seem to be succeeding. This must be the excuse for the interruption in these notes, which started life with the intention of being a diary.

Our tour of Detroit commenced with a run through the city, and then our coaches entered the Rouge River Works of the Ford Motor Company at East Dearborn and travelled along the various roads in the works. The trip was conveyed to give us a general idea of the lay-out and of the sequence of manufacturing operations of this huge plant, which covers over two square miles and which sometimes has as many as 100,000 employees. Stops were made at the most interesting points, and then we returned to our hotel for lunch.

After lunch we returned to the Ford plant and paid a more detailed visit to the foundries, steelworks and rolling mills. A description of this visit must be deferred until a later article.

In the evening we were entertained to dinner and dancing by the Detroit foundrymen and their ladies at the club-house of the Detroit Golf Club, the most extensive and luxurious "nineteenth hole" the writer has ever had the privilege of visiting. Mr. S. Wells Utley, President of the Detroit Steel Castings Company, welcomed the visitors in an eloquent address, and representatives of the Mayor and of civic and commercial institutions were present. The reply of the guests was given on this occasion by Mr. A. Brizon, Vice-President of the French Foundry Association, whose remarks were translated by Dr. Vanzetti.

Arrangements were made for more plant inspections on Wednesday. A number of the visitors elected to visit Saginaw and Vassar, a trip which involved over 200 miles of motoring in cars kindly provided by our hosts in Detroit. This was one of the most interesting days of the tour, for the visits included the permanent mould foundry of the Eaton-Erb Foundry Company, this visit being under the guidance of Mr. Fred Erb, who visited Great Britain in 1929, and who is well known to British foundrymen. We also visited the Saginaw Malleable Iron Division of General Motors, which has an output of 550 tons per day, and the Chevrolet Grey Iron Foundries of General Motors, where as much as 2,150 tons has been melted in a single day. At lunch the visitors were the guests of the Saginaw Rotary Club, and Mr. Makemson voiced the greetings and thanks of the guests.

The journey from Detroit to Cleveland was made by steamer across Lake Erie. Unfortunately, we were unable to appreciate fully the beauties of this trip, as the journey was made by night, Cleveland being reached about 7 a.m. on Thursday, October 18.

At Cleveland we were welcomed by a host of friends, and we made many new ones. Our friend, Mr. Avey, who accompanied us throughout the tour, now had the co-operation of many of his associates in the Penton Publishing Company, including Mr. Pat Dwyer, Mr. Froggett

and Mr. F. G. Steinebach. Other friends whom we met and who are known to British foundrymen included Mr. Ralph H. West, of the West Steel Casting Company, and Mrs. West. Works visits filled up a busy morning, while the afternoon was devoted to more visits or to a visit to the Dairy Exhibition. At a luncheon given by the Cleveland foundrymen, Mr. West presided, and an address was given by the President of the Chamber of Commerce, Mr. Herman Neff. Mr. Makemson was the representative of the visitors who replied, and on the instructions of the local committee he astonished his friends (and himself) by making part of his speech in French. In the evening the party left for Pittsburgh, arriving in the City of Steel (some people say "smoke," but it is not really smoky) about 11 p.m. on the same day.

A host of Pittsburgh foundrymen met us at our hotel, including Mr. Frank Lanahan, the President of the A.F.A. We also renewed our acquaintanceship with Mr. Snyder, of the Pittsburgh Rolls Corporation, who visited the Institute of British Foundrymen in 1923, and we met Mr. Frank Bird, of Armstrong-Whitworth's, who is attached to Mr. Snyder's company at present.

Our progress from works to works on Friday in Pittsburgh was more impressive than our journeys through Buffalo. About 20 private cars, loaned and driven by our Pittsburgh friends, travelled in procession through the crowded streets. A "speed cop" on motor-cycle led the way; another "speed cop" brought up the rear. All traffic was held up by our leader. We dashed over crossings when the red light was against us, traffic coming across our track with the green light in its favour being held up until the procession had passed. One-way streets were entered in the wrong direction; we travelled on the wrong side of the road, traffic coming in the opposite direction being hastily pushed to one side, and street cars were held up so that our progress would not be impeded. The City of Pittsburgh and the County of Alleghany showed their hospitality by inviting us to break all the motoring regulations of a much-regulated country. Our drivers never enjoyed themselves so much before, and the police enjoyed it, too.

Works visited at Pittsburgh included those of the Damascus Bronze Company, the Glass Tube Factory of the General Electric Company, and the impressive plant of the Mesta Machine Company, who commenced by showing us their "light work"—steel castings of 70 tons. When we saw some of 150 tons, we were incapable of further astonishment, but we understand they are willing to tackle 250-ton castings if they get the chance.

Our day at Pittsburgh concluded with a dinner given by the Pittsburgh Foundrymen's Association. On this occasion, the spokesman of the visitors was Prof. Alcacer, the leader of the Spanish delegation. Mr. H. Spence-Thomas, Vice-President of the Iron and Steel Institute, also replied for the visitors, and proposed a toast to the ladies. Mr. Thomas created a mild sensation by insisting that the company should drink this toast by standing with one foot on the chair and the other foot on the table—and everybody did it. This incident is mentioned as proof that none of us was in the state when one finishes a dinner under the table. At the conclusion of the dinner we took part in a meeting of the Association.

Week-end at Washington

The greater part of Saturday, October 20, was occupied by the railway journey from Pittsburgh to Washington. The line passes through the Alleghany Mountains, and most of the journey is very picturesque. The hills and valleys were ablaze with the tints of autumn, which, incidentally, are more vivid and show greater contrasts than the autumn colourings at home.

Washington is the most European-looking city which we have visited. There are no skyscrapers, the prevailing styles of architecture being European. Many of Washington's numerous public buildings would not look alien in Whitehall or on the Quai d'Orsay. Its streets are wide and tree-lined, and numerous gardens and small parks give the city an air of restfulness that is absent from the more typical American cities which we had previously visited. Sunday and Monday were devoted to sightseeing, and by some of us to rest, because our programme had been a full one and loss of sleep due to numerous night journeys was beginning to have its effect.

Whilst in Washington, Mr. Avey received a message from the White House conveying the wishes of President Roosevelt to us for a pleasant stay in his country and a successful Congress.

On Sunday afternoon the party visited the Arlington National Cemetery, and on our behalf a wreath was laid on the tomb of the Unknown Soldier. A short and impressive address was given by Mr. James Smith. Visits to Washington's home at Mount Vernon, the Capital and other public buildings of the capital of the Republic filled up the brief week-end, and on Monday evening, October 22, we arrived at Philadelphia, ready to begin the Conference proper.

The enthusiasm shown in a Conference of the A.F.A. is extraordinary. From 9 a.m. to 5 p.m., or even later, day after day, the Conference is in session; frequently four sessions are held simultaneously, and all are well attended. Americans appear to take their Conferences seriously, and every speaker's words are carefully followed in the search for inspiration and for new ideas.

The official opening took place on Tuesday morning in the large ballroom of the Philadelphia Convention Hall. There was an attendance at this meeting of at least 800 people, and Mr. Frank Lanahan, President of the American Foundrymen's Association, was in the chair. The Mayor of Philadelphia welcomed the Convention to the city, and Mr. Lanahan then welcomed the overseas visitors in a most charming speech. Mr. T. Makemson, secretary of the International Committee of Foundry Technical Associations, then called the roll of the visiting associations. The principal delegates of each country then stood up as their names were called, and one delegate replied to the welcome from each country. Mr. Delport rendered most valuable assistance as interpreter of the replies which were not in the English language. The delegates named on behalf of Great Britain were:—Mr. James Smith, representing the National Ironfounding Employers' Federation; Mr. H. Spence Thomas, representing the Iron and Steel Institute; Mr. J. B. Allan, representing the British Cast Iron Research Association; and Mr. T. Makemson, representing the Institute of British Foundrymen. Some amusement was caused when Mr. Makemson called his own name, the President insisting upon his bowing to the meeting to indicate that he was present. The reply on behalf of all the British delegates was made by Mr. James Smith.

International Committee Meeting

A meeting of the International Committee of Foundry Technical Associations was held at the Benjamin Franklin Hotel in the afternoon. In the absence of Prof. Pisek (President) and Prof. Gierdziejewski (Vice-President) the chair was occupied by Mr. J. Leonard, President of the *Association Technique de Fonderie de Belgique*. The other delegates were:—United States, Mr. Lanahan, Mr. Dan Avey and Mr. Delport; Great Britain, Mr. James Smith and Mr. Makemson, who was also present as secretary; Spain, Prof. Alcacer; Italy, Dr. Guido Vanzetti and Dr. Luiga Norsa; Poland, Mr. Watha-Kosicki; Germany, Prof. Piwowarsky and Dr. Jungbluth. Mr. John Penton also attended the meeting for a short time. Mr. Delport had a busy time, as he translated into English all the remarks made in French, and *vice versa*. In addition to the usual formal business of the meeting, several items of general interest were discussed. Mr. Leonard announced that the European Congress, to be held in Brussels in 1935, would probably take place in September of that year. In a discussion on the International Dictionary of Foundry Terms which is in preparation, Mr. Kosicki gave an interesting *résumé* of the work which is being carried out by the Polish Association. Prof. Gierdziejewski, of Warsaw, was elected President of the Committee for the year 1935, and the Belgian Association was invited to nominate the Vice-President for the same year. The meeting concluded with votes of thanks to the American Foundrymen's Association for facilities provided for the meeting, to Mr. Delport for acting as interpreter, and to the secretary.

During Tuesday evening a reception was given to overseas delegates and ladies in the magnificent new buildings of the famous Franklin Institute. There was also a large attendance of members of the A.F.A. and ladies. The Institute contains many valuable pieces of mechanical and electrical apparatus, many of which are of unique historical interest, and all of which were available for inspection. There was also a demonstration showing the development of talking pictures from the first crude efforts of a few years ago to the very latest coloured talking pictures, the sound reproduction of which was perfect. The evening concluded with a demonstration in the Planetarium. With the aid of a curious-looking and complicated piece of apparatus in the centre of the room, the whole of the dome-shaped roof was made to represent the night sky, all the planets being shown in the correct relative positions. The movements of the sun and the moon were explained in detail, and we were able to see in a few minutes the whole of the solar movements which take place in a day, in a month, and in a year. This was a really beautiful demonstration; in fact, scientific instruction in the form of entertainment.

On Wednesday, October 24, a banquet was held at the Bellevue-Stratford Hotel. Mr. Lanahan again presided, and Mr. D. M. Avey called the roll of the overseas delegates, each of whom rose in his place as his name was called. Mr. Leonard, representing all the overseas visitors, replied to the welcome, his remarks being interpreted into English by Mr. Delport. The J. H. Whiting medal was presented to Dr. Arnold Lenz, of the General Motor Corporation, by General T. S. Hammond, in recognition of the contributions made by Mr. Lenz to progress in foundry technology. Mr. Andrew Robertson, Chairman of Directors of the Westinghouse Electric & Manufacturing Company, gave an address, in which he dealt with several aspects of the National Recovery Administration, or the "New Deal" as it is called in the United States, and proved amusingly sarcastic about many aspects of Government control in industry.

It is impossible to deal adequately with the large number of Papers and discussions at the Conference. The Paper by Dr. W. H. Hatfield on "Steel Castings," which was the official Exchange Paper of the Institute of British Foundrymen, was presented on behalf of Dr. Hatfield by Mr. H. Spence-Thomas, Vice-President of the Iron and Steel Institute. The Paper elicited an unusually good discussion, among the speakers being such well-known steelfounders as Mr. John Howe Hall, who presided over this session, Major Bull of Chicago, and two Britons now in the United States, Mr. F. A. Melmoth and Mr. George Batty, who is director of the Steel Castings Development Bureau. A member of the European party, Mr. Allen, of the Staveley Coal & Iron Company, also took part in this discussion.

The Conference concluded on Friday, October 26, with a visit to the plant of the Bethlehem Steel Company. Due to the necessity of arriving in New York on the same day *en route* for home, a number of the overseas delegates had to omit this visit.

The Exhibition of Foundry Equipment and Materials

Foundry exhibitions in America are organised by the American Foundrymen's Association, and are usually on a large scale. The exhibition organised this year was smaller than usual, due to economic conditions, but it was nevertheless a much larger show than many similar exhibitions held in Europe. The exhibition was held in the magnificent new Convention Hall in Philadelphia, the Congress being also held in the same building.

Economic conditions were also responsible apparently for a paucity of actual foundry equipment in the exhibition. Many equipment manufacturers were represented, but, with notable exceptions, they contented themselves mainly by displaying models and photographs of their larger manufactures. A very large proportion of the exhibition was allocated to manufacturers of foundry supplies, such as pig-iron and non-ferrous metals, sands, abrasives, refractories, facings, core binders, and general furnishings.

Conspicuous among the exhibits showing plant in operation were several exhibits of fettling and cleaning plant. Three firms, namely, the American Foundry Equipment Company, the Pangborn Corporation and the W. W. Sly Manufacturing Company, showed sand-blast plant in which no compressed air is used, the abrasive being projected on to the casting by centrifugal force. A description of the "Wheelabrator" made by the American Foundry Equipment Company, and applied to a tumbling barrel, will serve to indicate the general principles.

The essential part of the "Wheelabrator" consists of an impeller into which the abrasive material is fed. The impeller is housed in a casing and is placed on the top of the tumbling barrel, the axis of the impeller being at right-angles to the axis of the tumbling barrel. A constant stream of abrasive, about four inches wide, is projected along the full length of the barrel, and as the castings in the barrel rotate, each casting passes under the stream of abrasive as it is brought to the top of the barrel. Rumbling and abrasive cleaning are thus carried out at the same time. The "Wheelabrator" is driven by a 15-h.p. motor, and it is claimed that at least 100 h.p. would be necessary to carry out the same amount of cleaning by compressed air. It is also claimed that there is an entire absence of dust in the neighbourhood of the machine. The abrasive, after use, is drawn off by a fan.

The tumbling barrel shown was of considerable size, and was fitted with automatic loading and discharging devices, thus almost eliminating manual operations in the cleaning of the castings. The whole of the operations of loading, cleaning and discharging is said to occupy from 7 to 15 minutes, according to the class of casting which is being cleaned, and plants are made with capacities of from 500 to 1,700 lbs. of castings. "Wheelabrators" were also shown applied to blast cabinets and rotary cleaning tables.

Another interesting exhibit was that of the Spencer Turbine Company, who showed a multi-stage, centrifugal turbo-compressor supplying blast to a cupola. Moulding machines, mostly of the jolt-squeeze type, were shown by several firms, whilst core-blowing machines were on view on the stands of the Osborn Manufacturing Company and Messrs. W. Demmler & Bros. The machine displayed by the latter company is designed for blowing cores for six- or eight-cylinder automobile engines.

In melting equipment, we observed a Detroit rocking electric furnace and a model of an Ajax-Wyatt furnace was shown by the Ajax Electric Furnace Corporation. The Whiting Corporation, who are large manufacturers of cupolas, relied mainly upon cinema films to display their extensive range of products.

Sand-conditioning and aerating plant was exhibited by two or three companies, and the National Engineering Company had in operation the latest type of Simpson intensive sand mixer.

A number of exhibitors showed displays of ferro-alloys and alloy-iron castings for various applications. Conspicuous among these exhibits was that of the International Nickel Company, who had a comprehensive and intelligently-arranged display of typical application of ferrous and non-ferrous castings using nickel alone or in conjunction with other alloys.

s.s. "Champlain," October 27, 1934.

The Congress is now at an end, and most of the European delegates and ladies have left for their own countries. The Italian party is sailing on the "Conte di Savoia" to-day, although a few of their number have remained behind to transact business and make further plant inspections. The party on this boat consists of the same persons as on the outward journey on the "Lafayette," with the exception of Mr. Vicaire, one of the French delegates, who will return to Europe later. Another British delegate, Mr. J. B. Allen, who crossed about a week previous to the main party and who joined us in New York, has also remained in the United States for business reasons.

Mr. and Mrs. Dan Avey and Mr. and Mrs. Fred Erb very kindly travelled to New York in order to be present at our departure, and did not leave us until they had seen us comfortably installed on the ship. It is impossible to describe the great kindness with which we were received by these ladies and gentlemen, and, in fact, by numerous American friends and their ladies. Mr. Avey, who is well known as the editor of "The Foundry," and who is President-Elect of the American Foundrymen's Association and chairman of its Committee on International Relations, met us at the pier at New York on our arrival, accompanied us throughout the tour, and finally left us only a few minutes before we sailed for home. During parts of the tour he was accompanied by Mrs. Avey and Miss Avey. Mr. and Mrs. Erb, who will be remembered as having taken part in the International Congress in London in 1929, were with us during our stay in Detroit, and then rejoined us at Washington and remained with us until our departure. In each city which was visited the local foundrymen and their ladies met us on arrival (frequently very early in the morning), entertained us to lunch or dinner during our stay, placed themselves unreservedly at our disposal during our stay, and in many cases furnished automobiles to convey us to plants which were visited. All were most anxious that we should obtain the maximum benefit from our visits, and our hosts took infinite pains to arrange visits to plants of interest to individual members of the party. Everywhere we experienced sincere and unlimited American hospitality.

We first met Mr. Frank Lanahan, the President of the American Foundrymen's Association, when we visited Pittsburgh, and we saw him frequently during the Conference in Philadelphia. Mr. Lanahan's cheery and friendly personality helped to break down any remaining barriers of naturality or shyness which might have existed. One simply cannot help but feel at home in the presence of this genial Irish-American. Many old friends who have visited congresses in Europe welcomed us, in addition to those who have already been mentioned. Dr. James Mackenzie, of Birmingham, Ala., sent so many messages to his friends in Great Britain that we have had to make a list of them, and so many friends sent messages to Mr. V. C. Faulkner and Mr. John Shaw that we have of necessity had to compile further lists. Among other friends we met Mr. David McLain and Mr. H. M. Lane. We cannot fully express our thanks and our gratitude to our hosts; we are sure, however, that they would not wish us to say more than that their arrangements for our reception were completely successful in every respect and functioned without a hitch. This we can say, and we do say it quite sincerely and with gratitude.

Finally, one is glad of the opportunity to acknowledge the valuable work of Mr. Vincent Delport, the European manager of "The Foundry" and European representative of the American Foundrymen's Association. In conjunction with Messrs. Thomas Cook & Son, Mr. Delport spent many months in working out the details of the tour and in making all kinds of special arrangements to suit the individual requirements of various members of the party. His personal help at all times was invaluable to all the European delegates of many nationalities. At the various meetings and social functions he frequently acted as interpreter, often at a moment's notice, and the manner in which he carried out this difficult work won the admiration of Americans and Europeans alike. On behalf of us all we would like to say "Thank you, Mr. Delport."

It would be ungrateful not to acknowledge our appreciation of the arrangements of Messrs. Thomas Cook & Son and of the members of their staff concerned. Our tour in the States involved change of hotels almost daily, or alternatively a night journey. The whole of the numerous transfers of ourselves and our baggage were carried out expeditiously and without a hitch, and the whole of the arrangements from the time we left our homes in Europe until our return worked perfectly.

Catalogues Received

Steel Castings. "The Edgar Allen Steel Foundry Book—4th edition," is the title of the latest brochure emanating from the publicity department of Messrs. Edgar Allen & Company, Limited. The covers have been made from a blue-print of working drawings for a liner plate. This is effective, striking and unique, but we question whether it looks businesslike. It certainly catches the eye, but surely this idea is best utilised for a folder. This booklet is a thorough-going catalogue, meant to be retained and filed for subsequent use. It contains a mass of information really useful to the buyer and is a splendid advertisement for the firm's castings. This cover is actually a binder for a series of loose leaves, so that if others, like ourselves, are not particularly enamoured of it, they can transfer the contents to ordinary files. The letterpress is well written, but surely there is no need to reiterate the firm's name *ad nauseam*, as in the second column of page 5. Of all the sections, and there are none, the reviewer likes the last one best, for herein is crystallised information essential to the intelligent purchasing of steel castings. Of the illustrations, Figs. 46 to 51 stand out as the best in the catalogue, and it is obvious that a black background is indicated for reproducing the appearance of steel castings. In round terms, the reviewer is of opinion that, except for the binder, this is the most intelligently-compiled catalogue ever issued by the British steel-foundry industry.

Files. An interesting folder has been received from Edgar Allen dealing with files and rasps, which tells something of their manufacture and quite an amount of their performance. A graph has been included which can only be read with difficulty. This is rather a pity, as the information it discloses is distinctly useful. An offer is made on the back page for trial orders on the "satisfied or return" basis.

CIRCUMSTANCES BEYOND CONTROL of the officers caused an alteration in the regular monthly meeting date of the West Yorkshire Branch of the Institute of British Foundrymen. The next gathering will be on Saturday, November 17, when the members will be privileged to visit the extensive Phœnix Works, at Thornbury, Bradford, of the English Electric Company. This will be a particularly interesting occasion, and is certain to attract a large assembly.

A Suggested Method of Establishing Melting Costs in a Grey-Iron Foundry*

[*This Report is to be discussed before several Branches of the Institute of British Foundrymen and is intended to serve as a preprint.*]

Introduction

It should not be necessary to emphasise how essential it is for the management of a foundry to have a correct costing system. Particularly in times of strenuous competition, when prices are constantly reduced to attract business, those who are responsible for the fixing of prices and for the finances of an undertaking are completely in the dark as to when the business is operating at a profit or at a loss if no attempt be made to know the actual cost of production. At such times guess work is worse than useless and opens wide the door to a fool's paradise.

At any time, a correct costing system is necessary, because unless costs are known, one cannot be certain that they are recovered in the selling price. A costing system is the only means of actually measuring any profit made for a given rate of production, and of knowing what resources may become available out of income for further development. Costing also shows in what directions efficiency can be increased and waste eliminated.

A costing system should not be used simply to work out average costs for certain periods; this would only be sufficient in the exceptional case of a foundry manufacturing one class of castings. In the large majority of cases the production of a foundry comprises several types of castings of different weight, and different also owing to the quality of the metal and the complication of the casting itself.

Where these conditions obtain, each class of castings should be costed separately; otherwise, and unknown to the management, the profit made on some classes of castings can easily be nullified, partly or in whole, by a loss made on other types. If selling prices be based arbitrarily on an average cost of production, certain castings will be quoted at a price that will discourage customers, whilst others will be offered at such a low price as unfairly to depress the market.

A correct costing system is, therefore, an essential requirement for the individual foundry; but it would be in the interest of the industry as a whole if a *standard* set of principles were adopted by the foundries to arrive at the cost of production. If such a standard system were adopted, costs would be established on a comparative basis; differences in costs for given types of castings would then be accounted for by the particular circumstances of each foundry, due to proximity of sources of supply, transport facilities, management and efficiency. In fact, a standard cost system would be a measure of a foundry's efficiency, allowing, of course, for the material conditions under which the foundry must operate.

It can be considered as an axiom that if it were possible to take into account exactly all the factors that intervene in the production of a given casting, there is only one figure that would truly represent the cost of producing that casting. In other words, if the same casting were reproduced under identical conditions, the same cost figure would be arrived at. In practice, however, it is not possible to cost each individual casting separately with sufficient accuracy to arrive at the exact figure; too many factors are spread over a certain volume of production, and many of those factors fluctuate; furthermore, if it is a case of estimating, a number of factors must themselves be estimated.

In working out costs over a period, all factors must be taken into account and absorbed in the cost, and the cost figure arrived at will be correct, provided that the principles governing the system are sound. When costing a given job (as, for instance, a 1-ton casting) or when costing for a class of castings, only a close approximation to the exact figure can be arrived at. It can be stated, however, that if a correct procedure be used consistently, the cost figure will be sufficiently close in each case for all practical purposes. On the other hand, it must be emphasised that if the costs arrived at by different systems are widely different, only one system may be correct, and all the others are wrong.

A system embodying the principles that have been adopted by experienced firms, which obtain consistently comparable figures that can be interlocked (without discrepancy) with the financial accounts of the undertaking, can be considered as a sound system. It is the object of this Sub-Committee to elaborate a system based on the best current practice in use by the most up-to-date foundries, and thus to propose a standard set of costing principles which can be adapted to the requirements of various types of foundries, and acceptable to the industry as a whole.

Divisions of the System

The manufacture of a casting, owing to its very nature, is the result of a number of definite processes. The metal must be melted; moulds must be prepared in which the metal will be cast; in a large number of cases, cores must be made and placed into the mould. Finally, before being shipped, gates, heads and risers must be removed from the casting, which must have a clean appearance and generally pass inspection.

Each of these stages involves a special type of labour and should bear a certain quota of overhead charges or on-costs. It is, therefore, necessary to divide the costing system itself into a number of sections, each corresponding to a department of the foundry. This division enables costs to be checked at each stage, provides for a fair allocation of costs to different types of castings, and also permits of a closer control of the working of each department.

The four main divisions of the system correspond to the following departments:—

I.—Melting Department.
II.—Moulding Department.
III.—Core Department.
IV.—Cleaning Department.

In addition, there are a certain number of auxiliary departments that contribute to the proper functioning of the manufacturing or productive departments listed above. Among the most usual auxiliary departments are:—(1) Carpenter's shop; (2) patternshop; (3) maintenance department; and (4) heat, light and power. This Paper is concerned exclusively with the melting department of a grey-iron foundry.

Factors Governing Melting Costs

The object of the system, as applied to the melting department, is to arrive at the *cost of the metal at the spout per ton of good castings produced*. Both for the purpose of estimating a job or calculating actual costs over a period of time or for a given job, the value or cost of all of the following factors that intervene in the operation of the melting department must be known, by the means of properly-kept records and inventories:—

(A) Price of the various brands of pig-iron and alloys.
(B) Value of own scrap
(C) Price of bought scrap.
(D) Price of coke.
(E) Price of limestone.
(F) Price of ganister, bricks, supplies and tools.
(G) Wages (direct and indirect labour).
(H) Cost of repairs and maintenance of melting plant.
(I) Cost of power for blowers and any other mechanical device requiring power.
(J) Other departmental on-costs which, according to the circumstances of the case, should be charged to the Melting Department, such as cranes, lifts, whole or part of laboratory expenses, etc.
(K) Percentage of fixed charges, which in certain cases should be charged to this department.

The price of items (A) and (C) to (F) should be the price "delivered at the yard."

The following records must also be carefully kept:—

A.—Inventory of the stocks of pig-iron, alloys, returned scrap, bought scrap, coke, limestone, ganister, etc.

B.—Weight of each charge going into the cupola, each component being weighed separately.

C.—Weight of gates, runners, risers, wasters, over-run, etc., which return to the stock of own scrap.

D.—Weights of good castings, obtained from the foundry, cleaning and shipping departments.

E.—Weight of foundry tackle.

F.—Daily cast report.

Loss of metal in melting and handling will be calculated from the above records.

When estimating a job, items *B*, *C*, *D* and *E* must be calculated, not forgetting metal losses.

The costs of the Melting Department comprise:—(1) Cost of metal; (2) cost of melting; and (3) on-costs.

1.—Cost of Metal

The customer should be charged with the actual cost of the *metal going into good castings, delivered*, plus the cost of metal losses arising from the making of those castings. He should *not* be charged with the cost of the metal going into the scrap returned to stock, exception being made for high-priced additions, which, once they have been melted with the iron, have practically lost their value in the scrap; therefore, the total cost of alloys should be charged. The metal costs include the cost of pig-iron, bought scrap and own scrap, and of any additions (ferros, nickel, etc.). The cost of pig-iron, additions and bought scrap are obtained from the corresponding inventories.

With regard to the value of own scrap, there seems to be a considerable difference of opinion on this point. In some cases, returned scrap is valued at the price of pig-iron, sometimes it is valued at current scrap market prices, and in some cases it is valued at a fancy figure, often absurdly low.

There also appears to be some confusion of thought about the meaning of scrap value. Some consider what we would term the "metallurgical" value of returned scrap; scrap continually remelted gradually loses its metallurgical value, and its market value may then be less than that of bought scrap of good quality. On the other hand, the metallurgical value of returned scrap may be enhanced by the addition of alloys to the charge. What the costing system is concerned with is the actual cost of producing the scrap, which has no direct relation to its metallurgical value; if that cost of production is recovered, the final cost figure of the casting will be correct.

Actually, the value of own scrap (as metal) is that of the metal mixture from which it originates. Assuming, for example, a cupola in which nothing but pig-iron at £4 a ton and scrap originating from the same brand of iron are charged, the value of the scrap for costing purposes will be £4 a ton. Actually, in this hypothetical case, the "metallurgical" value of the scrap would be less, because through successive remelts it has lost some of its qualities (oxidation, Mn content decreases, S content increases), but its metal value is £4, for it comes

* Tentative proposals submitted by the Costing Sub-Committee of the Institute of British Foundrymen. Convenor, Mr. V. Delport.

from iron that has cost £4. If bought scrap at £3 a ton is then introduced into the cupola and the charge is in the proportion of 10 cwts. of pig-iron, 5 cwts. of own scrap and 5 cwts. of bought scrap, we have:—

Example A.

	£	s.	d.
10 cwts. of pig-iron at £4 a ton	2	0	0
5 ,, of own scrap at £4 a ton	1	0	0
5 ,, of bought scrap at £3 a ton	0	15	0
	£3	15	0

The value of the metal mixture is £3 15s. a ton, and that is the value of the scrap obtained from this mixture; that is what it has actually cost to obtain that scrap, and that is the cost that must be recovered.

It will be seen that for a cupola operating with varying compositions of charges, over a certain period, the value of returned scrap will fluctuate. If a separate inventory of returned scrap were kept, it should be possible, at any time, to have the average value of this scrap.

The following detailed table illustrates the point.

We assume that the stock and inventory of returned scrap are started with 3 tons, valued at £3 15s. per ton.

	Inventory.		
	Tons.	Value.	Value per ton.
		£ s. d.	£ s. d.
3 tons scrap returned at £3 15s. 0d. = £11 5s. 0d.	3	11 5 0	3 15 0
2 ,, ,, ,, ,, £3 14s. 0d. = £7 8s. 0d.	5	18 13 0	3 14 7
1 ton taken out at £3 14s. 7d. = £3 14s. 7d.	4	14 18 5	3 14 7
3 tons scrap returned at £3 12s. 0d. = £10 16s. 0d.	7	25 14 5	3 13 6

At this point the average metal cost of the returned scrap is £3 13s. 6d. a ton, no account being taken of handling charges.

Example A would then be as follows:—

	£	s.	d.
10 cwts. of pig-iron at £4 a ton	2	0	0
5 ,, of own scrap at £3 13s. 6d. ..	0	18	4
5 ,, of bought scrap at £3	0	15	0
	£3	13	4

The cost of the metal mixture is £3 13s. 4d., and scrap returned to stock will be debited to the inventory at £3 13s. 4d. The value per ton of the stock of returned scrap will change accordingly.

Theoretically, this would be the correct method of calculating metal costs, and it shows that the actual cost of producing own scrap can be known. In practice, however, a rather complicated procedure would be required to weigh separately the scrap coming from different melts. A method must, therefore, be adopted that will give an approximate figure for returned scrap, with a margin of safety which ensures that the cost of returned scrap is duly recovered. It is recommended, therefore, that returned scrap charged into the cupola be valued at the same price as the pig-iron. The following table shows the effect on metal costs of the various ways of valuing returned scrap. In column (*a*) the scrap is valued at the average price of pig-iron; in column (*b*) at what would be the correct inventory price (£3 13s. 4d.) in our example; in column (*c*) at market price (£3 per ton):—

Example B.

	(*a*)			(*b*)			(*c*)		
	£	s.	d.	£	s.	d.	£	s.	d.
5 cwts. pig-iron at £4 per ton	1	0	0	1	0	0	1	0	0
5 ,, pig-iron at £3 16s.	0	19	0	0	19	0	0	19	0
5 ,, own scrap ..	0	19	6	0	18	4	0	15	0
5 ,, bought scrap at £3	0	15	0	0	15	0	0	15	0
	3	13	6	3	12	4	3	9	0

It will be seen that if returned scrap is only valued as bought scrap, as in column (*c*), the metal cost will be 3s. 4d. per ton less than if the inventory figure is used, as in column (*b*). The customer will, therefore, be charged so much less than if the price is based on actual costs—as it should be. If returned scrap is valued the same as the average price of pig-iron, as in column (*a*), the cost is actually inflated by 1s. 2d. per ton. Therefore, to make sure that the cost of own scrap is recovered, and assuming that keeping a detailed inventory of returned scrap is not practicable, it is best to value this scrap at the price of pig-iron. If two or three grades of pig-iron are used in the charge, the closest approximation is to value the scrap the same as the lowest price of pig-iron, as follows:—

	£	s.	d.
5 cwts. of pig-iron at £4 per ton	1	0	0
5 ,, of pig-iron at £3 16s.	0	19	0
5 ,, of own scrap at £3 16s.	0	19	0
5 ,, cwts. of bought scrap at £3 ..	0	15	0
	£3	13	0

This is only 8d. per ton more than by using the scrap inventory price.

2.—Cost of Melting

The customer should be charged with the total melting costs applying to all the metal charged into the cupola for making up his order. Whereas in the case of metal costs the customer is only charged with the cost of the metal going into castings, delivered, plus metal losses, in the case of melting costs he should be charged also with the cost of melting the scrap that is returned to stock, *i.e.*, gates, runners, wasters, over-run, etc.

The melting costs include primarily the following items:—Direct labour, indirect labour, value of coke used, power, materials ex-stores (limestone, ganister, etc.).

If in a week 50 tons of metal have been charged, we might have the following figures to illustrate melting costs:—

	£	s.	d.
Direct labour	10	0	0
Indirect labour	0	10	0
Coke (5 tons at £3 per ton)	15	0	0
Power	3	15	0
Materials ex stores	1	12	6
	£30	17	6

Therefore, the cost of melting 1 ton of metal charged into the cupola would be 12s. 4d.

3.—Oncosts

A distinction should be made between departmental oncosts, which apply direct to the melting department, and fixed charges, a share of which may be charged to this department. Departmental overheads in the melting department consist mainly of plant repair and maintenance, laboratory expenses and plant depreciation. Plant repair and maintenance covers the cupola plant; cranes and lifts used for the operation of the melting department, which includes the stock yard, blowers, electric gear, etc.

Laboratory expenses must be charged according to circumstances. If a laboratory is used exclusively for cupola control and metal analysis, it should be charged to the melting department. If a laboratory is used also for testing sands, for mechanical tests on castings, for micrography, etc., it should be possible to break up the laboratory expenses between the melting department and the foundry, each bearing a share as a departmental oncost. Plant depreciation will be discussed later.

Fixed charges in the melting department comprise a share of rent or depreciation on buildings, insurance and local taxation, in proportion to the area occupied by the melting plant and the stock yards (pig-iron, scrap and coke). Departmental oncosts and fixed charges applicable to the furnace should be worked out as a cost per ton of metal charged, and added to metal costs and melting costs.

Before giving examples showing how we arrive at the final melting cost, we would first refer to the methods of arriving at losses of metal in melting, handling, etc.

Assuming that 360 tons of metal have gone through the cupola, the records show, for instance, that this tonnage has given:—

		Percentage of total melt.
Good castings	180 tons	50 per cent.
Foundry scrap	144 ,,	40 ,,
,, wasters	10 ,,	3 ,,
,, remelt	8 ,,	2 ,,
	342 ,,	95 ,,

The 18 tons that are not accounted for, which correspond to 5 per cent. of the total melt, are the metal losses. A check should be made as follows:—Assuming that at the beginning of the week there is a stock of 200 tons of pig-iron and 50 tons of scrap; at the end of the week there has been produced, say, 180 tons of good castings, for which part of the pig-iron has been melted, and scrap that has passed through the cupola a certain number of times; at the end of the week there remains 32 tons of scrap and 20 tons of pig-iron in stock; the losses will be:—

$$(200 + 50) - (180 + 32 + 20) = 18 \text{ tons.}$$

This should very nearly check with the figures obtained direct.

The following examples will serve to illustrate the principles suggested by the Sub-Committee. It is realised that it is possible to follow these principles and arrive at a correct cost figure by slightly different methods. For this reason, these examples are given in different form, to suit individual requirements.

Example I.

A very simple case, in which it is assumed that the tonnage of good castings obtained is equal to 50 per cent. of the metal charged into the cupola, the metal losses are 5 per cent. of the total charge, and 45 per cent. of the charge is returned as scrap, in the form of gates, runners, wasters and overrun. One grade of pig-iron is used, priced at £4 per ton, own scrap is valued at the same price, and bought scrap at £3. The cost of 1 ton of metal mixture is £3 15s., assuming that the charge is composed of 50 per cent. of iron, 25 per cent. of own scrap and 25 per cent. of bought scrap:—

	£	s.	d.
10 cwts. pig-iron	2	0	0
5 ,, own scrap	1	0	0
5 ,, bought scrap	0	15	0
	£3	15	0

Melting charges amount to 12s. 4d. per ton of metal charged. Oncosts are assumed to be 1s. 6d. per ton of metal charged. (A), (B) and (C) show methods giving directly the cost *per ton of good castings*:—

	£	s.	d.
(A) Cost of 1 ton of metal mixture	3	15	0
Cost of melting sufficient iron to produce 1 ton of good castings (2 tons at 12s. 4d.)	1	4	8
Metal losses (5 per cent. of 2 tons 2 cwts. at £3 15s. per ton)	0	7	6
Oncosts, on 2 tons	0	3	0
	£5	10	2

In this case the cost of the metal going into 1 ton of good castings is taken, with the melting costs and oncosts for the quantity of metal (2 tons) necessary to produce 1 ton of good castings, the loss of metal on those 2 tons, and

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the oncost. The cost of the metal going into returned scrap is not charged. The cost of 1 ton of good castings, £5 10s. 2d., is arrived at directly.

(B)	£	s.	d.
Cost of 2 tons of metal (necessary to obtain 1 ton of good castings)	7	10	0
Cost of melting 2 tons	1	4	8
Oncosts on 2 tons	0	3	0
	8	17	8
Less 45 per cent. = 18 cwts. scrap returned at £3 15s.	3	7	6
Cost, 1 ton good castings	£5	10	2

In this case the cost of all the metal required for obtaining 1 ton of good castings is figured; it includes, therefore, the cost of metal lost and the cost of metal going into returned scrap. This last item must, therefore, be credited back. It will be noted, both under (A) and (B), that returned scrap is credited at the same value as that of the metal mixture from which it originates, which, as explained before, is the actual cost of that scrap.

(C)	£	s.	d.
Cost of 1 ton of metal	3	15	0
Cost of melting 1 ton	0	12	4
Oncosts, on 1 ton	0	1	6
	4	8	10
Less 9 cwts. scrap returned	1	13	9
Cost of 50 per cent. = 10 cwts. good castings	2	15	1
Cost of 1 ton good castings	5	10	2

This is method (B) modified.

These methods are useful for estimating a job, when weights of finished castings, gates and runners, etc., have been calculated, and wasters and metal losses have been estimated. If costing for a weekly period, for a total melt of, say, 100 tons, giving 50 tons of good castings, the following method, based on (A), is suggested:—

(X)	£	s.	d.
Cost of 50 tons of metal at £3 15s.	187	10	0
Cost of melting 100 tons	61	15	0
Metal losses (5 tons at £3 15s.)	18	15	0
Oncosts, on 100 tons of metal melted	7	10	0
Cost of 50 tons of good castings	275	10	0
Cost per ton of good castings	5	10	2

This can also be worked out as per methods (B) and (C).

Example II.

This example is a little less simple than the first. It is assumed that the charge is made up of:—

	£	s.	d.	
One grade of pig-iron at	4	0	0	per ton.
" " "	3	16	0	"
Own scrap at	3	14	0	"
Bought scrap at	3	0	0	"

The charge is composed of 25 per cent. of each of the above items, and the cost of the metal mixture is, therefore, £3 12s. 6d. per ton. It is assumed that the tonnage of good castings is 60 per cent. of the total tonnage of metal charged, metal losses 5 per cent., and scrap returned 35 per cent.; melting costs, 12s. 4d. per ton; oncosts, 1s. 6d. per ton of metal charged. This example is tabulated as Example I:—

	£	s.	d.
(A) Cost of 1 ton of metal	3	12	6
Cost of melting sufficient to produce 1 ton of good castings (33⅓ cwts. at 12s. 4d. per ton)	1	0	7
Metal losses (5 per cent. of 33⅓ cwts. at £3 12s. 6d. per ton)	0	6	0
Oncosts on 33⅓ cwts. at 1s. 6d. per ton	0	2	6
Cost, 1 ton of good castings	5	1	7
(B) Cost of metal necessary for 1 ton good castings (33⅓ cwts.)	6	0	10
Cost of melting	1	0	7
Oncosts	0	2	6
	7	3	11
Credit 35 per cent. of charge for scrap at £3 12s. 6d. per ton (11⅔ cwts.)	2	2	4
Cost, 1 ton good castings	£5	1	7

(C)	£	s.	d.
Cost of 1 ton of metal	3	12	6
Cost of melting 1 ton	0	12	4
Oncosts on 1 ton	0	1	6
	4	6	4
Credit 35 per cent. = 7 cwts. scrap at £3 12s. 6d.	1	5	4
Cost of 60 per cent. = 12 cwts. good castings	3	1	0
Cost, 1 ton good castings	5	1	7

(X) Based on (C)	£	s.	d.
Cost of 100 tons of metal at £3 12s. 6d.	362	10	0
Cost of melting 100 tons at 12s. 4d.	61	14	0
Oncosts on 100 tons at 1s. 6d.	7	10	0
	431	14	0
Credit 35 per cent. = 35 tons scrap at £3 12s. 6d.	126	17	6
Cost of 60 per cent. = 60 tons good castings	304	16	6
Cost, 1 ton good castings	5	1	7

In this example the last method (X) is the easiest and most straightforward with regard to calculations.

Example III.

This is supposed to be taken from actual results, but the figures are chosen at random. Methods (A) and (X) are shown. It is assumed that the cost of the metal (pig-iron and scrap), as charged, is £3 17s. 5d. per ton; melting costs, 10s. 4d. per ton; oncosts, 1s. 8d. per ton. The total tonnage of metal charged for a week is 96 tons 17 cwts. 2 qrs. The result is as follows:—

	Tons.	Cwts.	Qrs.	Of melt.	
Good castings	52	5	2	53.95	per cent.
Returned scrap	39	13	1	40.95	"
Metal losses	4	18	3	5.10	"
	96	17	2	100.00	"

(A)	£	s.	d.
Cost of 1 ton of metal	3	17	5
Cost of melting sufficient to produce 1 ton of good castings (1.855 tons at 10s. 4d.)	0	19	2
Metal losses (5 per cent. of 1.855 tons at £3 17s. 5d.)	0	7	2
Oncosts on 1.855 tons at 1s. 8d.	0	3	1
Cost, 1 ton good castings	£5	6	10
(X) Cost of metal: 96 tons 17 cwts. 2 qrs.	374	19	9
Cost of melting	50	1	0
Oncosts	8	1	5
	433	2	2
Credit scrap: 39 tons 13 cwts. 1 qr. at £3 17s. 5d.	153	10	6
Cost of good castings: 52 tons 5 cwts. 2 qrs.	279	11	8
Cost, 1 ton good castings	£5	6	11

In all these methods the results are consistent, because the same principles apply, and any method of setting down the figures that complies with these principles would give the one and only correct figure for the melting cost of 1 ton of good castings.

It has already been stated that different classes of castings should be costed separately if a correct price is to be fixed to each type. In order to arrive at a correct result, castings should be differentiated in regard to the weight of scrap (gates, runners, risers, etc.) obtained. For heavy castings, the weight of scrap may be relatively lower than for light castings. This difficulty can be overcome by weighing separately the scrap coming from the various types of casting, and costing each class separately, dividing oncosts between them on a tonnage basis. A simpler, but less accurate method, is to calculate the average cost of the total production, and slightly increase the cost for light castings, reducing it in proportion for the heavier castings.

When foundry tackle is made for general use, it should be costed separately and capitalised. If foundry tackle be made for a specific job, its cost should be established and charged to the job.

A.S.T.M. Specifications and Tests for Coal and Coke

For the first time a compilation of all the standard and tentative specifications and tests for coal and coke, as issued by the American Society for Testing Materials, has been published. This includes five specifications, thirteen methods of test and the standard definitions of terms relating to coal and coke.

Foundry coke and gas coking coals are covered by specifications, and, to make the pamphlet complete, the recently-approved requirements for classification of coal by rank and by grade developed by the Sectional Committee on Classification of Coals are included.

One of the important activities of A.S.T.M. Committee D-5 on Coal and Coke, which is sponsor for the publication, is the development of satisfaction-sampling procedures. In this compilation are given the methods of laboratory sampling and analysis of coal and coke, and procedure for sampling coal; also sampling coke for analysis.

The standard tests for the cubic-foot weight of coke and of crushed bituminous coal are included, as well as the methods of sieve analysis of these products and tests for the fineness of powdered coal. The shatter and tumbler tests for coke are detailed; also the method of determining volume of cell space of lump coke and testing for size of anthracite. An important test for the agglutinating value of coal, issued in the form of a proposed draft, is given.

Copies of this publication, aggregating 108 pages in heavy paper cover, can be obtained from the American Society for Testing Materials, 260, South Broad Street, Philadelphia, price one dollar. On orders for ten or more copies special prices are in effect.

Publication Received

Handbook for Electric Welders (4th Edition). Edited by J. H. PATERSON, D.Sc., and published by Murex Welding Processes, Limited, Ferry Lane Works, Forest Road, London, E.17. Price 2s. 6d. net.

Although this is the 4th edition, we fail to remember having seen the earlier issues of this handbook, and thus no comparison can be made, but we notice from the introduction that the more elementary portions of the earlier editions have been eliminated. The book is just the type required by the average foundry manager, whether he manufactures steel, iron or non-ferrous castings. Foundrymen will learn with no little astonishment on page 77 that semi-steel contains 1.50 to 3.50 per cent. carbon and is used for steel castings. Is not the time ripe for the complete elimination of this name from metallurgical nomenclature, as it obviously is misunderstood by everybody except the man who makes it?

The scope of the book embraces the supply of current electrodes, practical welding of mild steel, welding cast iron, stainless steel, copper and bronze, metallography, physical properties of welds, strength of welds and systematic control, together with a number of appendices. We sadly missed an index, which we deem to be an essential in any book purporting to be in any way scientific. One other feature—as welds are small castings, capable of being converted into small forgings by hammering—this feature should receive more prominence, whilst the finishing of welds is certainly worthy of a more complete study, as surface condition can influence tensile strength very materially. The book is obviously popular—it has run into four editions within two years—and we are thoroughly satisfied that it is excellent value for money.

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The British Cast Iron Research Association

ANNUAL MEETING AND LUNCHEON

The annual meeting and luncheon of the British Cast Iron Research Association was held at the Hotel Victoria, London, on Wednesday, October 31. Major F. A. Freeth, D.Sc., F.R.S. (President), was in the chair on both occasions.

ANNUAL MEETING

The SECRETARY read the notice convening the meeting, and announced that apologies had been received, for inability to attend, from Sir Harold Hartley—immediate Past-President—through indisposition, Dr. C. H. Desch, of the National Physical Laboratory, and a number of members and friends.

The Minutes of the previous annual meeting held in London on Wednesday, November 1, 1933, were taken as read and confirmed.

On the motion of the President, which was duly seconded, the thirteenth annual report and accounts were unanimously adopted, an abstract of which is presented below.

ANNUAL REPORT

During the year under review, ended June 30, 1934, the total income received was the highest in the history of the Association, £10,632. Of this the sum of £400 is non-recurring, but even allowing for this, the income is higher than that of the year 1930-31, the best hitherto recorded. That year was the last in which grant was received on the original £ for £ basis. For each of the three subsequent years, the last of which is the year under review, the grant received was £3,000 and the fall in grant by a sum approaching £2,000 during this period was gradually made good from industrial sources. Some important developments with respect to future grant payments are referred to more fully below. While it is gratifying to report that the fall in income has been made good, the three-year period in question has been one of considerable difficulty as a consequence of the endeavour to maintain an increasing activity with a temporarily diminished income. Members realise increasingly the services which the Association can render and there has been a very material increase in the number of technical inquiries received. These inquiries have always been an important part of the work of the Association and are welcomed. They keep the Association in touch with the difficulties experienced in the industry and have an important reaction on the research programme. At the same time on a stationary or diminishing income, increase in one direction is bound to be accompanied by some restriction in another. It is hoped that this period of difficulty is now ended.

Council and Officers

The Twelfth Annual General Meeting was held in London on November 1, 1933, the retiring President, Sir Harold Hartley, C.B.E., M.C., F.R.S., being in the chair. During the meeting his successor as President was elected, Major F. A. Freeth, C.B.E., D.Sc., F.R.S., and Mr. J. Cameron, J.P., and Mr. H. James Yates were re-elected Vice-Presidents. Sir Harold Hartley was warmly thanked for his services to the Association during his period of office and was unanimously elected an honorary member. Over 120 members and guests attended the luncheon held after the meeting and the speeches were reported fully in our columns.

The Council re-elected Mr. H. B. Weeks, F.I.C., as chairman, and Mr. J. T. Goodwin, M.B.E., as vice-chairman. Six Council meetings have been held during the year with an average attendance of 17. The Council is indebted to the Iron and Steel Institute and to Imperial Chemical Industries, Limited, for loan of rooms for meetings.

The Council greatly regrets to record the death during the year of Dr. W. Rosenhain, F.R.S., who was for many years a member of Council and an active and valued adviser. The announcement of his death at the age of 58 evoked world-wide sympathy and many tributes to his outstanding ability as a metallurgist of international reputation.

The principal Committees of the Council, Research, Publications, and Education Committees were re-elected. The Research Committee held four meetings during the year with an average attendance of 16. The detailed work of the committee is dealt with through eight sub-committees and seven meetings of these have been held, with an average attendance of 12. A complete list of committees and sub-committees is given in Appendix I and a reference is made in Appendix III to the research and development programme. In view of extension of the work in hand, referred to more fully below, the programme is now under revision by the Research Committee. Dr. H. Hartley was unanimously elected chairman of the committee and some of the leading features of the work done are described below. The Publications Committee unanimously re-elected Mr. W. B. Parker, F.I.C., as chairman, and the Education Committee similarly re-elected Mr. E. R. Briggs, M.Inst.C.E., as chairman, and the two committees held four meetings during the year. The Advisory Committee of chairmen and past-chairmen of the main committees, which deals with emergencies and with matters on which early decision is required, has met twice during the year.

RESEARCH AND DEVELOPMENT

Graphite Refinement

The most important developments during the year refer to a means of achieving a greater degree of graphite refinement in cast iron, and are likely to apply to both pig and cast irons. While the immediate application is to grey irons, the principles involved will apply to the white, chilled and malleable irons. The marked effect of size and distribution of graphite on the properties of cast iron is generally recognised. Much of the advance made in the past few years on strength of cast iron has been made by reducing graphite size, and this has been rendered possible mainly by the reduction of the total-carbon content. The lowering of the total carbon, however, brings certain founding difficulties in its train. The metal is more liable to be mottled or white on pouring, has greater shrinkage in the foundry, and requires melting at higher temperatures, which may increase the difficulties with respect to refractoriness of moulding sands. The range of temperatures over which the metal is fluid enough to pour into sound castings is shorter. A few years ago the Association's Senior Metallurgist was able to demonstrate that by suitably controlling conditions of melting it was possible to secure irons not only with graphite in the ordinary flaky condition but also in an extremely finely divided condition known as "supercooled." Subsequently, the effect of various gases in the metal was studied and it was found possible to change the structure from one type to the other by treatment with suitable gases. The matter was carried further and it has been possible to evolve a process in which, by a suitable addition to the metal and a comparatively simple after-treatment while molten, it is practicable on a laboratory scale to secure graphite in the extremely divided supercooled form, regardless of the original total-carbon content. Previous attempts to secure this finely-divided graphite throughout a heavy section have been only partially successful, and the Association has demonstrated that the presence of both types of structure referred to in one casting results in a metal of poor mechanical properties, although either exclusively is quite satisfactory. Patent protection for the process has been applied for in the interests of members, and commercial trials are being undertaken in members' foundries so far as the limited staff available permits. It is sufficient, however, to state here that it has been possible, on laboratory melts of 100 lbs. or 200 lbs., to increase mechanical properties of an ordinary No. 3 pig-iron by 50 per cent., without alteration of composition, simply by virtue of the treatment. It is of particular interest to note that the reverse process, that of producing flake graphite from supercooled graphite, has now also been accomplished and it is now practicable to produce refined or coarsened graphite as required. Occasionally in practice the mixed structure appears and the solution of the problem of carrying out reversed process not only greatly facilitates a proper explanation of the phenomena but may have some important results in practice. Six reports on this process have been made available to members during the year.

Alloy Cast Irons

Further work has been done and several reports circulated on the heat-resisting cast irons Silal and Nicrosilal. About a dozen members of the Association are licensed to produce these alloys and their application in service presents a number of problems of considerable variety and interest. The original work carried out in the laboratories of the Association has now been confirmed in Papers presented to scientific societies in or published in the technical Press of Germany, France and Belgium, the latest Paper being that by Prof. Thyssen, of Liège, to the Iron and Steel Institute, on the occasion of its recent visit to Luxemburg. A beginning has been made on the study of the effect of molybdenum, an effect which is generally acknowledged to be of a remarkable character for the size of the addition made. Further experiments have been made during the year in conjunction with members on the production of high-quality alloy cast irons made by the inoculation process, and members have been satisfied that the production of such irons is commercially quite practicable. One such iron, made by a member and containing about 1 per cent. nickel, was reported in a Paper by the Director to the Spring Meeting of the Iron and Steel Institute as having a tensile strength of nearly 29 tons per sq. in. This iron is a low-carbon iron containing 1 per cent. nickel. There are definite commercial possibilities in high-quality cast irons having strengths of this order.

Sands and Refractories

During the year a report on Recommended Methods for the Testing and Control of Foundry Moulding Sands has been issued and widely circulated, and it is now possible for any foundry to embark on the testing of moulding sand with access to all the necessary information on apparatus and technique. Full details of apparatus required and methods of procedure are given in the report and a large part of this apparatus has been designed and evolved by the Association. An Appendix to the report gives information on the choice of apparatus, with manufacturers and prices, and a series of figures is also incorporated giving the results of tests on the recommended apparatus using sands from different parts of the country. A further important report circulated exclusively to members has been prepared on binders for core sands, a large number of binders—proprietary and otherwise—having been tested with various sands.

Since the close of the year arrangements have been made to transfer from Sheffield the work hitherto carried on in the Refractories Department by Dr. J. G. A. Skerl to headquarters at Birmingham, a suitable area of the extensions

referred to in the last report having been used for this purpose. This transfer has been envisaged for several years, but has hitherto been held up for financial reasons. The calls on Dr. Skerl's services by members for reports on problems relating to sands and refractories has made centralisation of this work an administrative necessity and the change will benefit the general work in progress. At the same time the removal does not imply any abandonment of the principle of encouraging research in other institutions, and opportunity is taken here to express the Council's appreciation to Mr. W. J. Rees, who is in charge of the Refractories Department of the University of Sheffield, for his continued interest and assistance in sands and refractories work carried on in his department.

Melting Practice

The balanced-blast cupola makes very satisfactory progress. In the last report the number of cupolas installed or under construction was 41, having a total hourly tonnage of 275 tons. At present the number of cupolas installed or under construction is 61, having a total hourly tonnage of 386 tons. Very satisfactory reports continue to come from users. One of these furnaces has been erected within a few minutes of the Association's headquarters, at the foundry of Preston & Bishop, Limited, Clement Street, Birmingham. This furnace was erected in the main through the generosity of Mr. H. James Yates, Vice-President, to whom the warmest thanks of the Association are due. The cupola has an internal diameter of 24 in. and a rated output of 2.35 tons per hour. It forms an important addition to the Association's experimental resources, not only for making experimental melts, but also for tests on fuels and refractories.

Particularly gratifying reports on the balanced-blast cupola come from Australia, where the first one was installed at the works of T. Main & Sons Proprietary, Limited, Melbourne. This firm has undertaken to manufacture and supply or convert suitable cupolas in Australia, and a good deal of interest has been aroused by the successful operation of the first furnace which was operated solely on the Association's written instructions. Several other furnaces are under construction.

Some interesting figures were published during the year by the Scottish Coke Research Committee of tests on coke in various cupolas, and the consumption of charge coke was lower in the balanced-blast cupola than in any of four other furnaces used. The charge coke consumption for the balanced-blast cupola was 5.45 per cent. and ranged for the other furnaces up to 8.5 per cent. The results of an important series of tests by the staff of the Association have also been made available to members, giving figures for sulphur pick-up, carbon pick-up, metal loss, and production of slag in two different types of cupolas. The variation of composition in scrap normally makes these figures difficult to obtain, but in the tests referred to, careful estimates were made of the whole of the material both entering and leaving the furnaces.

Malleable and White Irons

The great pressure of general work and limited staff has prevented much work being done on white and malleable irons, although the possibilities of applying developments referred to above in grey iron to these fields has been fully borne in mind.

Foundry Pig-Iron

Following the meeting of makers and users of pig-iron referred to in the last report, the Pig-Iron Sub-Committee has left members for the time being to gain further experience on the practical working of the analytical tolerances suggested in Research Report No. 102 for the purchase of pig and refined irons. The British Iron and Steel Federation has, at the invitation of the Association, nominated two representatives to the Pig-Iron Sub-Committee, Major H. H. Jackson and Mr. G. H. Johnson.

Development Department

This Department deals with technical inquiries from members and with application to members' works of the discoveries made in the laboratories. During the year over 1,100 inquiries were received from members and reported upon, and a large number of visits were paid to members in connection therewith.

Work of an important and interesting character frequently arises from problems and inquiries submitted by members. Last year, following difficulties which were evident in the process of vitreous enamelling cast iron, two meetings of members were called to discuss the situation, and a general report was subsequently circulated. This year the matter has been followed up experimentally with the aid of samples from members showing the difficulties complained of, and a report has been prepared on the way the defects arise. Another report has been prepared on the causes of phosphide extrusions on the surface of castings, which have caused considerable difficulty from time to time in the industry.

The laboratories have been very fully occupied. In the chemical laboratory nearly two thousand duplicate estimations have been made, and in the metallographical laboratory five hundred and fifty micro-examinations were carried out, one hundred and fifteen of which have been recorded photographically in permanent form. In the mechanical testing laboratory over one thousand mechanical tests—tensile, transverse, compression, impact, and hardness—were made.

Scottish Laboratory

The work of the Foundry Technical Institute at Falkirk has proceeded normally and has been fully occupied with inquiries from Scottish members, to whom the Scottish Superintendent, Mr. H. Cowan, B.Sc., paid a number of visits.

Extra-Mural Investigations

The general financial stringency has prevented any extension of work done for the Association in outside institutions. Contact, however, has been maintained with a number of laboratories, and in particular a number of irons, ordinary and heat-resisting, have been supplied to the National Physical Laboratory for tests at elevated temperatures.

LIBRARY AND INFORMATION BUREAU AND PUBLICATIONS

Publications

During the year twenty-five research reports were issued or made available to members. Fifteen bureau reports and eight translations were also issued during the year. An index to publications issued during 1932-34 has been prepared for circulation to members. The "Bulletin" has been regularly circulated and the issue for April, 1934, completed Vol. 3, an index for which is in preparation.

The translation rights for the French language of "Recommended Methods for the Sampling and Analysis of Cast Ferrous Metals and Alloys" (issued to members as Research Report No. 105 and generally as Special Publication No. 1) were disposed of to *La Fonderie Moderne*, and the French edition appeared during the year.

Exhibitions

The Association participated in a joint research exhibit organised by the Department of Scientific and Industrial Research at the Shipping, Engineering, and Machinery Exhibition in September, 1933, and an official visit of members took place. The usual official visit to the British Industries Fair at Birmingham was also held in March.

Library and Information Bureau

During the year the number of accessions to the library was 440 and the total loans were 1,932. These figures show an increasing use by members of the library, as do the number of inquiries received in the Information Bureau.

Foreign Visits

Mr. John Cameron, J.P., Vice-President, and the Director represented the Association at the International Foundry Congress at Prague in September, 1933, the first to be held in Czecho-Slovakia. A lecture on the development of the balanced blast cupola in Great Britain has been given by the Director to the *Association Technique de Fonderie* in Paris, and a visit paid to the German Chemical Exhibition at Cologne.

Papers and Lectures

The Director presented a Paper to the Iron and Steel Institute spring meeting on the deflection, elasticity, and resilience of cast iron, and two Papers were given on the projected British Foundry School, referred to later. The first was given to the Birmingham, Coventry, and West Midlands Branch of the Institute of British Foundrymen, and the second to the Annual Conference of the Association of Technical Institutions in June, 1934.

EDUCATION

Foundry Education

The courses held at technical schools throughout the country, leading to certificates in pattern-making and foundry practice and science, issued by the City and Guilds of London Institute, are increasing in popularity and are filling a definite need. The same can be said of the National Certificates for mechanical engineering with endorsement in founding, issued by the Institution of Mechanical Engineers, and both are essential parts of a national scheme of foundry education.

Higher Foundry Education

The most important development during the year has been the scheme proposed by the Association for the establishment of a British foundry high school, completing the superstructure of the scheme of national foundry education referred to above. The proposals were approved by the Education Committee and later by the Council, and various bodies concerned with founding—research associations, technical institutions and trade associations—have been invited to support the scheme, which has been fully described in THE FOUNDRY TRADE JOURNAL for March 22 and April 5, 1934.

It is proposed to establish a course in founding lasting one academic year and providing instruction of the highest type, open only to those who are already in the industry and who have demonstrated their capacity for exercising higher responsibilities in it. In the majority of cases candidates will have had suitable preliminary education or will have taken advantage of part-time facilities in the evening technical schools and colleges, now available throughout the country. The number of students will not be allowed to exceed a suitable maximum, and it is hoped to arrange for the specialised teaching to be in the hands of nationally-known and recognised experts in the industry. It is proposed to pay visits each week to foundries and to have once a year a visit to other parts of the country. Such a course should appeal to those men who are, or who hope to become foundry managers, foundry engineers, foundry chemists and foundry metallurgists. There will be no distinction between cast metals and the course will cover both ferrous and non-ferrous metals. At the end of the course successful students will receive a diploma.

On the all-important question of finance, it is estimated that the inclusive cost of running the school will vary from £2,300 to £3,000 per annum for a minimum and maximum number of students respectively. Apart from fees, something like £2,000 will be required, and the Board of Education has undertaken to consider providing a grant of £1,500, subject to the industry furnishing the sum of £500 per annum. The

Board has considered the scheme very carefully and is anxious to see it established. Of the various institutions approached to support the scheme financially and to nominate representatives to the governing committee, about half-a-dozen have already agreed to do so. Nearly one-half of the £500 required from the industry is in sight, and as soon as the governing committee is formally established the industry will be invited to contribute the remainder. It remains to be added that the Association has been in close touch with the Department of Scientific and Industrial Research throughout the consideration which has been given to this matter, and the Department has given the Association every encouragement to proceed.

During the year the University of Sheffield announced its willingness to establish a course in metallurgy suited to founders leading to a degree. There is no overlapping between the two schemes, for the Sheffield scheme will apply essentially to undergraduates who have had no experience of the trade, while the Association's proposals concern those already in the industry. The Board of Education is satisfied that there is no duplication involved. Reference was made in the last report to the success of the Study Course held in October, 1933. Further developments of this are under consideration.

MEMBERSHIP

At the close of the year the total number of ordinary and trade members was 308, and of associate members 61. Affiliated associations of manufacturers have a membership of 39, the total subscribing membership thus being 408.

Foundries overseas which have British capital and directorate exceeding 50 per cent. of the total are eligible for membership of the Association, and it has for many years been represented in India, Australia and Canada. More recently members have been obtained in South Africa and New Zealand. The Council is indebted to three gentlemen who have kindly undertaken the duties of Honorary Correspondents in their respective countries; they are Mr. O. W. Ellis, M.Sc., of Toronto, for Canada; Mr. T. W. Main, of T. Main & Sons Pty., Limited, Melbourne, for Australia; and Mr. J. C. Mahindra, of Calcutta, for India.

STAFF

Following his serious illness, Mr. J. E. Fletcher, M.I.Mech.E., who has acted as consultant to the Association since 1924, was compelled to relinquish some of his active work, and the Council made arrangements for Mr. F. J. Cook, M.I.Mech.E., to advise on matters in which his great experience of the industry would be helpful. Mr. Fletcher continues, however, to prepare specifications for the balanced-blast cupola, the original design of which is, of course, due to him. Mr. L. W. Bolton has been elected an Associate member of the Institution of Mechanical Engineers and Mr. A. A. Timmins an Associate of the Institute of Chemistry, both by examination.

ANNUAL MEETING

Mr. H. B. Weeks, proposing the re-election of Major Freeth as President of the Association, said that like the previous Presidents of the Association, Major Freeth had done such valuable work for the Association that the Council was unanimous in recommending his re-election for a second year.

Mr. E. R. Briggs seconded and the re-election of Major Freeth was then carried.

The President, in expressing his appreciation of being re-elected, said he had come to the meeting prepared to sing his swan song, but, apparently, he was not to be allowed to do that. He regarded it as a very great honour to have been re-elected to the Presidency, and it was quite true to say he would do anything he could for the Association because the members of the Association had a very large interest in the trade of the country, and anything that could be done to reduce unemployment, having regard to the future, should command the support and attention of every patriotic man.

On the motion of Mr. W. Jolley, seconded by Mr. S. H. Russell, the following were re-elected Vice-Presidents:—Mr. John Cameron and Mr. H. James Yates, whilst Mr. A. McKinstry was elected a Vice-President.

The following members of Council retired automatically under Article 27, and were unanimously re-elected:—Major T. G. Bird, Mr. E. C. Evans, Mr. H. Field, Mr. J. T. Goodwin, Mr. J. E. Hurst, Mr. W. Jolley, Mr. G. T. Lunt, Mr. T. Makemson, Mr. G. Pate, Mr. A. J. Richman, Mr. A. W. Steven, Mr. R. W. Stubbs and Prof. T. Turner.

Messrs. Poppleton and Appleby were unanimously re-elected auditors for the ensuing year.

After a cordial vote of thanks was passed to the Council for their services during the past year, Dr. H. Hartley proposed a hearty vote of thanks to the scientific advisers of the Association, viz., Prof. Sir Harold Carpenter, Dr. C. H. Desch, Prof. D. Hanson, Mr. W. J. Rees and Prof. T. Turner, for their assistance during the past year, at the same time assuring these gentlemen that this was not a mere formal vote of thanks, but a sincere appreciation of the work they had done for the Association.

Mr. T. M. Herbert seconded, and the vote of thanks was accorded with hearty acclamation.

The President then proposed a vote of thanks to the Director and staff for the manner in which they had carried out their duties during the past year. It was very easy, he said, to say something of an eyewash nature when proposing such a vote of thanks, but he was deadly serious when he said that in Mr. Pearce the Association had a most admirable director of research, and an admirable director of research meant an admirable staff.

Mr. H. B. Weeks (Chairman of Council) said that, as one who was probably more closely in touch with the work of the staff than anybody else, it gave him the greatest pleasure to second this vote of thanks to the director and his staff. The staff deserved to be heartily thanked for their work during the past year. Prof. T. Turner also supported the resolution, and Mr. Pearce briefly acknowledged the vote of thanks on behalf of the staff and himself.

Mr. H. B. Weeks (Chairman of Council) moved the final resolution, which was a vote of thanks to the President for presiding at the meeting, remarking that any words of his would be superfluous in expressing the indebtedness of the Association to Major Freeth.

Prof. T. Turner seconded the motion, which was carried with hearty applause.

The President, acknowledging the vote of thanks, expressed the hope that when members found themselves in any difficulty in which they thought he might be of help, they would call upon him and bring it to his notice.

ANNUAL LUNCHEON

The annual luncheon followed immediately after the annual meeting, the President again being in the chair. As in previous years it was arranged that the President should give a short address after luncheon.

The President commenced by paying a tribute to the work of Mr. Pearce and his staff, and went on to say he was getting a little tired of begging. Taking a hypothetical case of a trade in Great Britain which was employing a very large number of men yet whose unemployment was increasing, and any reasonable man knew perfectly well that that unemployment was increasing, not because of wage cutting or anything like that on the part of foreigners but was on account of sheer technical inefficiency, would not the right course be to take the people responsible for that trade by the neck and say "you simply have got to do some research; we shall compel you to"? That attitude was becoming more and more necessary in England to-day. It was essential to get hold of the people outside and bring them into the Association. Continuing, Major Freeth said he wished to speak more particularly of some developments which the Association had in view. It had always been the view of the Council and officers that they should aim at an annual income of at least £20,000 to £25,000 in order to render the industry the kind and extent of services it needs. Indeed, for an industry of such magnitude, this figure was extraordinarily modest, being roughly one-tenth of 1 per cent. of the annual turnover of the industry. The past three years had been a little trying. Three years ago the basis of payment of grant was altered, and fell from nearly £5,000 per annum to £3,000 per annum, to earn which larger industrial subscriptions were required. In each of the three years the £3,000 grant was earned, but only in the year just closed was the drop in grant fully made up from industrial sources. Incidentally he spoke appreciatively of the sporting spirit in which the Department of Scientific and Industrial Research had always met the Association, and expressed the hope that those outside the Association would become aware of that. Whilst it was a source of satisfaction that this had been accomplished, the restriction, whilst it lasted, caused difficulties. For instance, it was impossible to increase the staff, yet the demands made by members in the form of inquiries showed continuous increase. In a few years they had increased from an average of just over one to nearly four queries per working day. It was inevitable that this should react on progress in research, involving a risk of drying up the source of part of the experience drawn upon in replying to inquiries.

New Work to be Undertaken

Continuing, Major Freeth said that fortunately the difficulties of the Association to which he had referred were disappearing. The Advisory Council for the Department of Scientific and Industrial Research had, during the current year, made a new proposal with regard to the grants. The industry had to raise £1,000 more this year in return for which the Department offered to increase the grant by £2,000, thus giving an opportunity of increasing the income by 25 per cent. to 30 per cent. This would greatly relieve the situation and would enable the Council to accelerate the present programme and secure new equipment. In addition, it was hoped to increase the research staff and to put in hand not only further work on special alloy additions and moulding sands, but also on the enamelling of castings and on malleable cast iron and pig-iron, and particularly on the general problem of shrinkage and contraction in cast iron. Of all problems outstanding this last was probably the one needing most attention, but hitherto it had been necessary to do much exploratory work before it was possible to proceed, except on rather empirical lines. The Association kept in close touch with members on foundry problems and developments, and it was hoped to strengthen the Development Department until there were at least six men who could deal with such matters and visit members' foundries. It was also desired to strengthen the Information Bureau and make the "Bulletin" a monthly publication. With regard to visiting members' foundries, there was nothing like making contact with those responsible, because in that way friendly relations were established with managers and foremen, which was quite impossible through the medium of written communications.

More Support Required

The Advisory Council, however, had gone farther than the offer he had mentioned. In addition to the extra £2,000, they would provide on the £ for £ basis up to a further £3,500, subject to the industry furnishing a similar amount. The Annual Report showed how this, achieved within five years, could yield an annual income of £20,000, which would bring the finances of the Association to the region sought. They were

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approaching halfway in the £1,000 to be obtained this year, and he asked for all the help possible to maintain the rate of progress, adding that no apology was made for wanting the money, because the Council believed that it could give a service which was well worth the subscription. The trouble was that eligible firms had to be approached individually, and this took time.

What is Fundamental Research?

The extra grant offered by the Department was intended in part to ensure the conduct of fundamental research, which it was difficult or impossible for any one firm to carry out and which was the special province of a research association. As a matter of fact, said Major Freeth, he felt that the words "fundamental research" had done serious harm, and one aspect might better be called "objective research," because nobody would actually undertake research in any direction which had no possibility of success. Fundamental research meant research for the purpose of obtaining knowledge of a general character in regard to their own particular processes, although such knowledge was bound to produce discoveries. Nevertheless, he was proud of the fundamental work which had been carried on by the Association continuously, because it was absolutely essential in such a very complicated material as cast iron. He welcomed the extra grant from the Department, also, for another reason. The Association was the only one exclusively devoted to the study of cast metal, and in a sense it held the pass for all users of metals, as nearly all metals assumed the cast form before they were wrought. The study of the cast state, both for metals used in the cast state and those subsequently wrought, had in the past been greatly neglected.

Ingot-Mould Research

This fundamental work was enabling founders to build up conceptions of what happened on solidification and cooling and the various influences which affected structure, and the point was now being approached at which it became profitable to consider investigations having a specific object in view. Having spent a good deal of his scientific work on solidification and allied problems, Major Freeth said he knew how easy it was to get out diagrams, which, however, entirely failed to work in practice, and, of course, a person was not interested when he was told that something might work a thousand years hence. The existing organisation, however, provided for fundamental work to be carried out, and he would like to see the whole of the experience gained systematically applied, for instance, to the improvement of specific types of castings. Thus, for ingot moulds for steel ingots, a panel could readily be formed of those members interested from the Grey Iron Sub-Committee, with the addition of all other members manufacturing such castings. This panel would be able to bring its combined experience to bear on the problem, and also offer facilities for works trials and bring about co-operation with users of ingot moulds. This would really carry development work to its logical conclusion and farther than was at present practicable.

Heat-Resisting Irons

The work being done by the Association on heat-resisting irons arose essentially from fundamental work which had now been confirmed a number of times in Europe in published Papers, but they had never been in a position fully to consider each application in industry as an independent problem, and he would like to see this remedied. The distribution of reports to all interested members would be simplified; some panels would necessarily be small, such, for instance, as those interested in what might be termed engineering light castings; others, for instance, such as those interested in vitreous enamelling, would be large. The Pig-iron Sub-Committee represented practically all producer members, and the enamelling group had recently virtually become such a panel.

Membership

Returning to the question of membership, Major Freeth stressed the point that the Association is a co-operative association and that the question of what a member put into it was just as important as what he got out of it. A few days ago the Duke of Kent had said in London that human societies were possible only if their members were prepared to make sacrifices for the common good. If societies were to exist, the individuals composing them must be prepared to make voluntary sacrifices for the common good or be compelled to do so, and the Duke had added, "It has been one of the outstanding achievements of our Anglo-Saxon civilisation that co-operation which is essential has come about not by compulsion but through voluntary association." Individualism, continued Major Freeth, tends to restrict such voluntary association, but their true competitor to-day was not their neighbour at home; he was abroad, and experience of foreign developments showed how essential was a strong, independent scientific body able to look after the technical interests of the country.

Reasons for Non-Support

The reasons received from firms for not supporting the Association were varied. One firm was too small; another was too large; one firm had its own laboratory, another had not. One firm had difficulty in interpreting and using the information sent out by the Association, whilst another could not be taught anything. All these, however, overlooked the co-operative principle which was expressed in social and national life in a hundred ways. Commenting that the Association duplicated the work of no other organisation, Major Freeth urged members to show their public spirit and help the Director in his task of raising the additional money required.

The Foundry School

Reference was then made to the proposed establishment of a foundry high school, a scheme for which had been approved by the Education Committee and the Council and had been put forward by the Association after much consideration. After agreeing with Sir Josiah Stamp in some remarks recently made to the effect that industrial life makes more claims on character and perseverance, on ability to adapt and to lead, than could possibly be indicated in the examination room, Major Freeth said it was felt, nevertheless, that the men who possessed these qualities, which had already brought them a measure of promotion and responsibility, need to-day some access to the technical and scientific information which is piling up so rapidly, and which is changing the whole face of the industry and the whole status of cast iron as an engineering material. What he liked about the foundry scheme was that the intention was to take men with a natural flair as moulders and give them the advantage of scientific training. It seemed to him that a man with the flair for foundry work plus the training that was contemplated could be turned into a genius. It was hoped to provide a one-year course of the highest type to men capable of profiting by it. Numbers would be limited, and it was hoped that firms in the industry would be prepared to release suitable men for a year for the purpose. The intention was to secure the services of nationally recognised experts for the specialised part of the instruction, and there would be no attempt to teach practical work, for practical experience could only be acquired in the foundry itself, and the students would have had this experience. When the scheme had been formally constituted it was proposed to appeal to the industry, and when he said that the support required from industry would only be of the order of £300 per annum, it would be agreed that its success must not be prejudiced for want of such a sum.

Study Course

A year ago he had reported on the great success of the Study Course which had just been held. That idea was to be developed further, but its most complete and systematic fulfilment would be in the foundry school in so far as existing knowledge and experience could be brought to bear. This school would have the friendly interest of the British Cast Iron Research Association as one of the constituent supporting bodies, and it would have a good deal of official and unofficial support. There would be no other connection between the Association and the school; it was right and proper that the Association should take the initiative, but it would undertake no obligations other than a constituent body.

In conclusion, Major Freeth expressed the view that important expansions will take place both with regard to the Association and school, and said that the continued sympathetic encouragement and support of industry was looked for. Finally, he expressed the thanks of the Association to the Advisory Council of the Department of Scientific and Industrial Research for their sympathy and human and cordial consideration on every occasion, and particularly for the new grant offer, which gave the Association new hope for the future.

The D.S.I.R. and the B.C.I.R.A.

SIR CLEMENT HINDLEY (Member of the Advisory Committee, Department of Scientific and Industrial Research), proposing a vote of thanks to the President for his Address, said he gathered from the President that it was pressure of foreign competition which had turned the minds of those in the industry to scientific methods, and he congratulated the Association on what had been achieved. In particular he expressed the satisfaction of the Advisory Council at the response which had been made at the Conference held last March for an expansion of the work of the Research Associations connected with the industries of this country. At that time, and indeed earlier, the co-operative research movement in this country needed a stimulus. The Advisory Council reviewed the whole position of research associations in this country, and felt there was a very urgent need to bring before the industries of the country the vital necessity of a more whole-hearted application of science to the improvement of manufacturing methods. It was said at that time that the future of this country as a producer of manufactured goods was at stake. It was a little humiliating to find that other countries which had originally learned their trade from us were out-stripping us in technique and also under-selling us not only in the world's markets but in the home market. It was believed that the remedy for this was an extension of the adoption of scientific methods, and it was on the basis of that belief that the Advisory Council put forward the movement for the expansion of co-operative research associations and, in fact, recommended to the Government that the best way of bringing about that expansion was further inducements by way of financial aid in order to stimulate the efforts of the industries. It was on the understanding that this additional assistance would hasten the day when the industries themselves would be able to bear the whole burden of research that the scheme was put forward. The response of the industries throughout the country to that appeal had been very encouraging, and already a number of research associations had definitely brought their activities to a higher level as the result of the additional grants that had been promised, on the recommendation of the Advisory Council. It was also a very great pleasure to him to be able to acknowledge the response that had been made in the cast-iron industry and by the Association to this appeal, which, as the President had pointed out, would enable the Cast Iron Research Association to raise its present

(*Concluded on page 298*)

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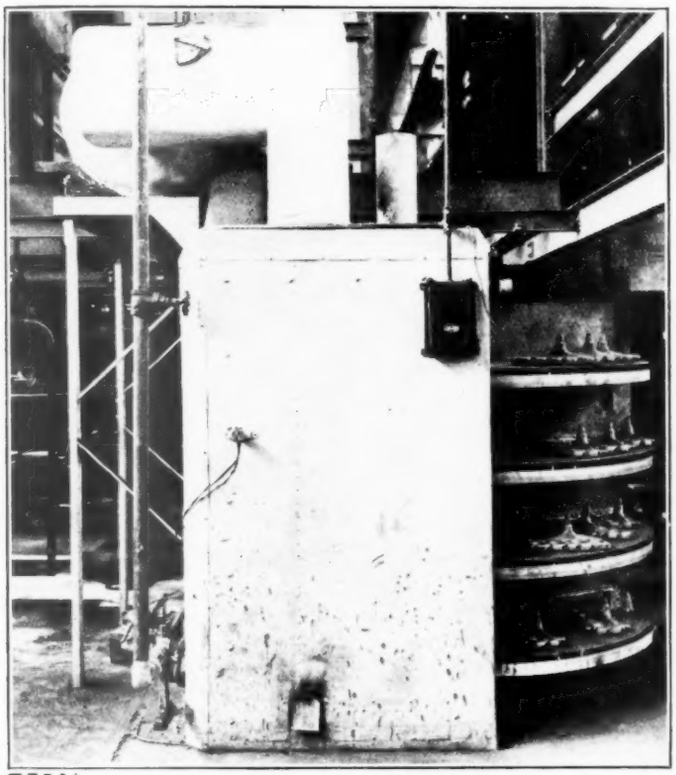

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This Week's News in Brief

Trade Talk

NEXT WEEK-END General Refractories, Limited, are celebrating the twenty-first anniversary of the inception of the company.

THE CONSTRUCTIONAL ENGINEERING COMPANY, LIMITED, Titan Works, Charles Henry Street, Birmingham, 12, inform us that their telephone numbers are now Midland 4753 and 4754.

THE IRISH ENGINEERING AND FOUNDRY UNION, 67, Dame Street, Dublin, has been elected to membership of the Irish Free State Agricultural and Industrial Association, whose object is the promotion of Free State industries.

BARIMAR, LIMITED, of 14-18, Lamb's Conduit Street, London, W.C.1, announce that they have now provided facilities for carrying out emergency welding repairs at night or over the week-end, in their own works and also on customers premises.

AS A RESULT of the public inspection of the liner "Empress of France," which was arranged by Messrs. Arnot Young & Company, Limited, Fullarton Ironworks, Tollcross, Glasgow, prior to breaking up the vessel, the sum of £168 has been handed to the Glasgow Western Infirmary.

THE GREAT SOUTHERN RAILWAY COMPANY OF IRELAND is erecting a new factory at the Broadstone terminus at Dublin for the maintenance and construction of both road and rail vehicles. About 200 workers will be engaged, and it is claimed that with the up-to-date plant to be installed, the factory will be one of the most modern of its kind in Europe. The new development will not affect the works at Inchicore, having become necessary owing to the large number of road-transport concerns recently acquired by the company.

A PERIOD OF REPLENISHING seems to have set in for Clyde shipbuilding, for the outstanding feature of the industry during October has been the number of substantial orders received. Ten vessels, four for the Admiralty, which are subject to the settlement of minor points of detail, have been ordered during the month. These new contracts do not by any means exhaust the possibilities that at least half-a-dozen vessels will be definitely placed in the next few weeks, and a number of important inquiries are in the market.

IN THE COURSE of a lecture on the "Bronze Age of Scotland," Prof. T. Bryce, at Glasgow Archæological Society, said that at the beginning of the art of metallurgy in Scotland, gold and copper were available, but there was no tin available. Bronze implied first a knowledge of two metals, both obtainable only by the reduction of metalliferous ores and mixed in certain proportions which could only have been arrived at by experiment; secondly, a knowledge of the geographical situation of the ores of copper and tin, generally found apart. This knowledge must have come from the intercourse of peoples.

British Cast Iron Research Association

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level of income by 100 per cent. This applied indeed not only to the income but to the activities of the Association. He gathered from what the President had said, however, that a very serious effort would be needed to obtain the necessary support from the industry, and he imagined that the Association would need to use all its powers of persuasion in an attack on the indifferent and the sceptical.

In conclusion, Sir Clement said that, having regard to the past record of the Association, he looked forward with confidence to the work it would do in the future, knowing as he did the enthusiasm of the Council and its director and staff. In this work he assured them of the wholehearted sympathy of the Advisory Council in the expansion of the work the Association was undertaking, and promised assistance at all times in any difficulties that might arise.

MR. P. V. HUNTER (President, Institution of Electrical Engineers) seconded the vote of thanks.

The PRESIDENT expressed his appreciation of the hearty vote of thanks he was accorded, and the proceedings terminated.

THE NEW TORPEDO BOAT DESTROYER "Escort," built by Messrs. Scott's Shipbuilding & Engineering Company, Limited, Greenock, for the British Admiralty, has completed acceptance trials on the Clyde and sailed for the South. The steamer "Hai Chen," built by Messrs. Barclay, Curle & Company, Limited, Whiteinch, Glasgow, for the China Merchants' Steam Navigation Company, Limited, has carried out successful trials on the Firth of Clyde. The new steam tug, "W. H. Fuller," built by Messrs. Harland & Wolff, Limited, Govan, Glasgow, for the South African Railways and Harbours Administration, has also completed trials.

A FEW MONTHS AGO Crane Company, of Chicago, installed a balanced-blast cupola having a melting capacity of 12 to 16 tons per hour. This is being used for the production of high-grade pressure-tested grey-iron castings. The cupola is operating very satisfactorily, and has resulted in a considerable saving in coke (approximately 33 per cent.). We understand that Crane Company have placed an order for the conversion of a further cupola, the specification for which is to be prepared by the British Cast Iron Research Association. As is well known, Crane, Limited—an associated company—have two balanced-blast cupolas producing malleable and grey cast iron for pipe fittings, radiators, boilers and valves, at their Ipswich factory.

THE AUDLEY ENGINEERING COMPANY, LIMITED, of Newport, in association with Mr. Edward Watkin Wynn, of Wrexham, and Mr. Kenneth Murray Leach, of Newport, have been granted Letters Patent No. 415,485 for improvements relating to cast iron. The claims are :—(1) A corrosion-resisting cast iron containing silicon, nickel and copper, the proportions of the essential constituents in addition to iron being :—Silicon, 4 to 10 per cent.; nickel, not less than 7 per cent., but less than 15 per cent.; copper, 5 to 12 per cent.; carbon, more than 1.5 per cent., but not more than 3 per cent., and the free carbon being in the coarsely-graphitic condition. (2) A corrosion-resisting cast iron as claimed above, and containing in addition to iron :—Silicon, about 6 per cent.; nickel, about 14 per cent.; copper, about 5 per cent.; carbon, about 1.8 per cent. (3) A corrosion-resisting cast iron as claimed above, and containing not more than 2 per cent. and preferably about 0.2 per cent. of antimony.

IT IS REPORTED that a Diesel engine built by Messrs. William Beardmore & Company, Limited, Parkhead, Glasgow, has given satisfactory results in the contest now nearing completion in Russia. There have been 47 different makes of commercial vehicles, with high-speed Diesel engines fitted, taking part in the competition, which included a journey across a considerable portion of Asia and passing over the mountain ranges of the Caucasus and Ural. During a large part of the journey the roads were very rough, and in parts axle deep in mud or sand. On returning to Moscow, the vehicles underwent speed tests on rough roads, and afterwards the engines were taken out and put through a series of trials on the test bed and subsequently stripped for examination. It is understood that the Beardmore vehicle has been placed amongst the first engines, and that it has behaved throughout the exacting trial in a faultless manner. It is confidently expected by the makers that, when the official results of the trial become available, the Dalmuir-built engine will be established in a leading position in regard to performance and reliability.

Company Reports

Glenfield & Kennedy, Limited.—Interim dividend on the ordinary shares of 3 per cent., less tax.

Samuel Osborn & Company, Limited.—Profit, after depreciation and income tax, £29,862; brought in, £8,494; dividend on the preference shares for the year to July 31 last, £8,712; dividend of 4 per cent., less tax, on the ordinary shares, £9,083; carried forward, £20,561.

Whitehead Iron & Steel Company, Limited.—Profit for half-year to September 30, 1934 (subject to audit) of £87,477, after setting aside £10,000 for depreciation and £14,000 as provision for income tax. An interim dividend of 10 per cent. actual, less tax, will be paid, absorbing £30,740. Profits for the complete financial year to March 31, 1934, amounted to £73,734, after allocating £20,000 to depreciation and £6,900 to income-tax reserve.

Personal

MR. A. SUTCLIFFE has informed us that he has changed his address, which is now :—10, Strawberry Hill Road, Bromwich Station, Bolton.

MR. AND MRS. ARCHIBALD BINGHAM, of 33, Double Row, Eglinton Ironworks, Kilwinning, have celebrated the fiftieth anniversary of their marriage. Mr. Bingham had been employed at Eglinton Works for many years prior to retirement.

MR. THOMAS TYRIE, who has been for many years connected with the technical staff of Messrs. Glenfield & Kennedy, Limited, Kilmarnock, and for the past five years as assistant metallurgist, has resigned in order to take up an appointment as assistant to the managing director of Messrs. Walter Macfarlane & Company, Saracen Foundry, Glasgow.

MR. GEORGE MILLER, foreman patternmaker at the Hammond Lane Foundry, Dublin, who has gone to take up a similar position in the Galway Foundry, was presented by his former colleagues with a clock and a solid silver condiment set. The presentation was made at the works by Mr. T. E. Graham, on behalf of his fellow-workers. Mr. Miller occupied the position of foreman patternmaker in the Hammond Lane Foundry for 20 years.

Will

DONALD, WILLIAM R., Aberdeen, retired ironfounder £4,041

Obituary

THE DEATH OCCURRED last week, in the Glasgow Western Infirmary, of Mr. William Smith, of 44, Revoch Drive, Glasgow. Mr. Smith was employed with Messrs. Babcock & Wilcox, Limited, Renfrew, for 27 years, and retired at the end of last year. He was unmarried.

MR. AUSTIN ASHTON LISTER, chairman of Messrs. R. A. Lister & Company, Limited, of Dursley (Glos), who died recently, was the third son of the late Sir Ashton Lister, and succeeded his father, the founder of the firm, on the latter's death in 1929. Mr. Lister gave his life to the service of his firm, which, from very small beginnings, has grown to the position it occupies to-day in the engineering industry. He travelled extensively abroad on its behalf, and he was one of the early commercial pioneers in Canada, in which he founded, and for a number of years managed, the Lister subsidiary company. Mr. Lister was a director on a number of other companies, and was a highly-respected figure in the engineering and agricultural industry.

Forthcoming Events

NOVEMBER 12.

Institute of Production Engineers :—"Some Notes on Modern Foundry Practice," Paper by E. Longden, at the Engineers' Club, Manchester, at 7.30 p.m.

Institute of British Foundrymen

NOVEMBER 13.

Burnley Section :—"A Day in a Foundry," Paper by F. Harris, at the Municipal College, Burnley, at 7.15 p.m.

NOVEMBER 14.

London Branch :—Suggested Method of Establishing Melting Costs in a Grey-Iron Foundry." Results of investigations by the Costing Sub-Committee, presented by the Convenor, V. Delport, at the Charing Cross Hotel (First Floor), London, W.C.2, at 8 p.m.

NOVEMBER 16.

Lancashire Branch (Junior Section) :—"Non-Ferrous Founding," Paper by C. A. Howe, at the College of Technology, Sackville Street, Manchester, at 7.30 p.m.

Middlesbrough Branch :—"A Few Notes on Continental Steel-Foundry Practice and Castings," Paper by J. G. Wrightson, at the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7.45 p.m.

Sheffield and District Branch :—"Suggested Method of Establishing Melting Costs in a Grey-Iron Foundry." Results of Investigation by Costing Sub-Committee, presented by a member of the Committee, at the Grand Hotel, Sheffield, at 7.45 p.m.

NOVEMBER 17.

Falkirk Section :—"Some Observations on the Enamelling of Light Castings," Paper by W. A. Shaw, at the Temperance Café, Lint Riggs, Falkirk, at 6 p.m.

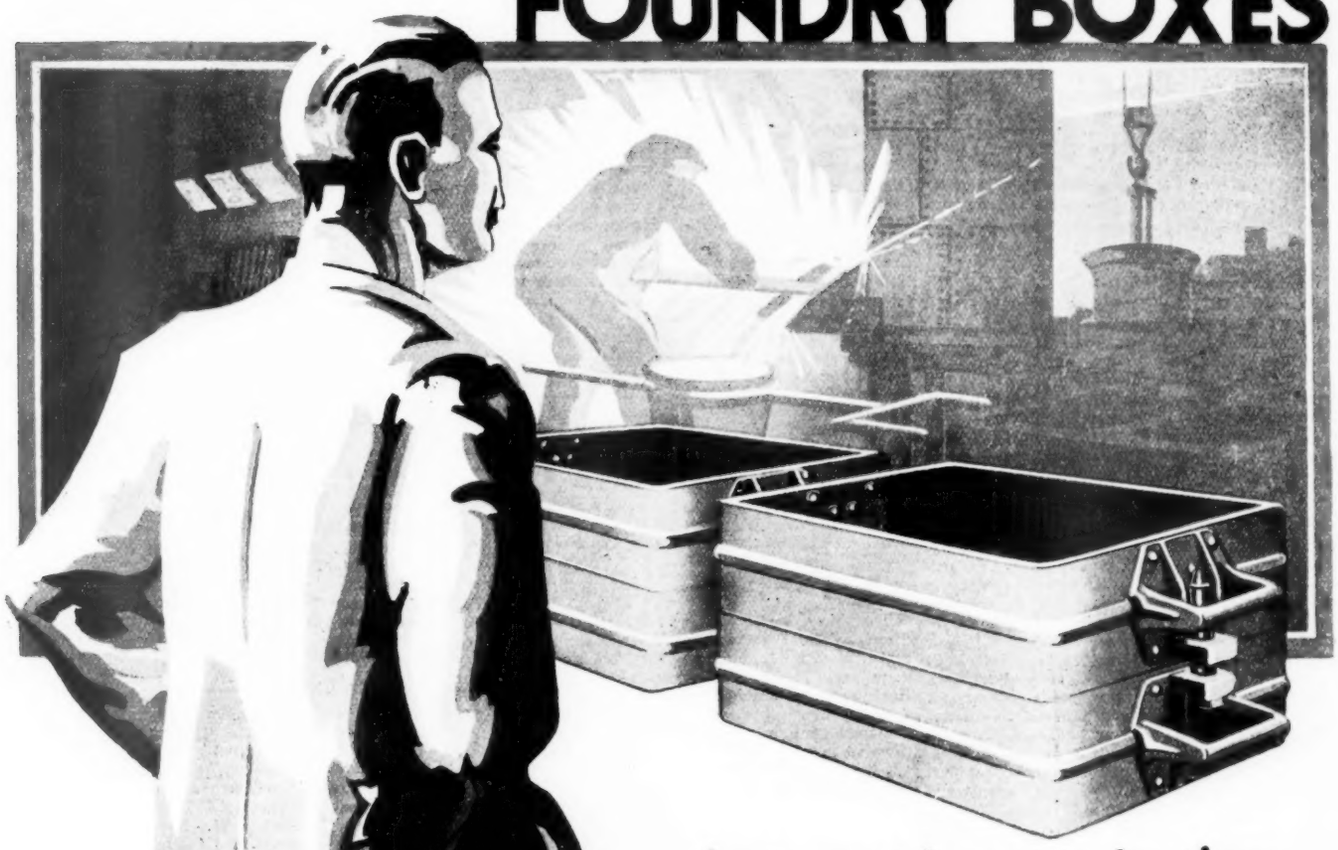
Lincolnshire Section :—"Suggested Method of Establishing Melting Costs in a Grey-Iron Foundry." Results of investigations by the Costing Sub-Committee, presented by C. W. Bigg, at the Technical College, Monks Road, Lincoln, at 7 p.m.

East Midlands Branch :—"Steel Castings," Paper by C. H. Kain, at the Technical College, Derby, at 6 p.m.

Wales and Monmouth Branch :—Joint meeting with Newport Metallurgical Association. "The Engineering Properties of Cast Iron," Paper by A. B. Everest, Ph.D., B.Sc., at the Technical College, Newport, at 6.30 p.m.

XUM

FOUNDRY BOXES



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One of the greatest improvements you can introduce into your foundry is the STERLING ROLLED STEEL MOULDING BOX . . . . the result is speed and economy all round. Your moulders will put down more moulds per day because of the light and easy handling properties of these boxes.

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AGENTS: GLASGOW - MANCHESTER - NEWCASTLE.

Raw Material Markets

The iron and steel markets retain their optimistic tone. An encouraging feature has been increased export business in one or two directions, whilst the volume of home trade shows no sign of falling away. The ironmasters generally express themselves as satisfied with the rate at which iron is going into consumption, although there has been a slight lull in activity at some of the light-castings foundries. It is hoped that the latter is merely a temporary feature.

Pig-Iron

MIDDLESBROUGH.—There has been a strong demand for Cleveland iron and, in view of the fact that only three of the 26 blast furnaces operating in this area are producing foundry iron for the open market, it is not surprising that the ironmasters have had to make withdrawals from stocks in hand. Not only has the home trade improved, but export business is also more promising. During the past week or two, good tonnages of iron have been shipped to Italy, Germany, Denmark and Finland. The prices quoted to home consumers, in the case of No. 3 Cleveland G.M.B., are 67s. 6d. delivered Middlesbrough, 69s. 6d. delivered North-East Coast, 67s. 3d. delivered Falkirk and 70s. 3d. per ton delivered Glasgow. No. 4 foundry and No. 4 forge iron are both 1s. per ton cheaper than No. 3 and No. 1 quality is quoted at 2s. 6d. per ton more than No. 3.

The demand for East Coast hematite has again increased, after a quiet period of several weeks. Bigger tonnages are being sent to the Sheffield and Midlands steelmakers, and it is understood that a number of long-term contracts are under discussion. The producers, however, are not inclined to commit themselves far ahead at the current quotations, in view of the rising tendency of raw-material prices. No. 1 hematite iron for home use is quoted at 69s. per ton delivered Middlesbrough, 71s. delivered North-East Coast, 75s. delivered Scotland, 75s. to 78s. delivered Yorkshire, 76s. delivered Lancashire, 79s. delivered Birmingham, and 83s. 6d. delivered London (by rail).

LANCASHIRE.—The pig-iron market in this area has a firm tone. Deliveries of Midland pig-iron to Lancashire foundries are now well up to the pre-holiday level, and current indications are that this satisfactory state of affairs will be maintained throughout the winter. Values are steady, with Midland brands of No. 3—Derbyshire and Staffordshire—quoted for delivery in the Lancashire zone on the basis of 74s. per ton, Northants at 72s. 6d., Derbyshire forge at 69s., Scottish No. 3 at about 82s. 6d., West Coast hematite at around 78s. 6d., and East Coast at 76s. for No. 1 and 75s. for No. 3.

MIDLANDS.—New orders for foundry iron are mostly for small tonnages, as the large majority of consumers are covered by long-term contracts. It is reported that slightly less iron is going into the light-castings trade. The controlled rates applying to Birmingham and Black Country stations are 67s. 6d. per ton for Northants No. 3, and 71s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, which prices are subject to small graduated rebates to large consumers. In addition to common iron, other qualities at varying prices are being purchased. Irons with medium-phosphorus content are to be obtained at any level between 72s. 6d., and 80s. per ton, and low-phosphorus irons, including Scottish brands, from 85s. to 87s. 6d. per ton. Where, owing to tests and the nature of the work, refined irons are required, the prices range from about £5 7s. 6d. to £6 10s. per ton delivered this area. There is little or no change in the hematite market.

SCOTLAND.—The demand for Scottish foundry iron is of a limited nature, present transactions being mostly of a hand-to-mouth nature. There is no departure from the official minimum of 70s. for No. 3 foundry f.o.t. furnaces, with 2s. 6d. extra for No. 1. Good deliveries of Cleveland iron are being taken by the light-castings founders. Quotations for No. 3 Cleveland remain at 67s. 3d. f.o.t. Falkirk and 70s. 3d. f.o.t. Glasgow, other English irons being available at slightly less.

Coke

The foundry-coke market retains its very firm tone. Current quotations for delivery in South Staffordshire are as follow:—Best Durham fuel, 36s. to 40s.; Welsh, 35s. to 45s. per ton. In some quarters increased quotations are looked for before the end of the month.

Steel

Steady business conditions rule in the steel markets, and while in one or two departments trading has become rather quieter, this is more than made up by gains in others. Export trade, although irregular, appears to be improving in spite of difficulties resulting from exchange movements, tariffs, and the restrictions upon imports in force in many oversea markets. Business in the semi-finished steel market has been quieter; but again this is largely due to most of the important consumers having ensured their supplies for a considerable period ahead. In a number of cases also consumers have laid in heavy stocks. Rather more imported Continental material has been sold in this market of late, but the greater part of the business coming on the market has been taken by the British works. Conditions in the finished-steel section are irregular. While some departments are busy others are experiencing a slackening in demand. This, however, is only to be expected after the active conditions which characterised the markets for several weeks.

Scrap

There is a healthy demand for scrap iron in most districts. In the Cleveland district, ordinary heavy cast-iron scrap is quoted at 53s. 6d. and machinery metal at 56s., but the best figure obtainable for light metal is not more than 41s. per ton. There is a steady demand for cast-iron scrap in the Midlands at unchanged prices. In South Wales less is being done in heavy cast iron in large pieces and furnace sizes, which is easier at 48s. 6d. to 50s. There is also only a limited call for light metal and machinery grade at 41s. to 42s. 6d. and 52s. 6d. to 55s. per ton respectively. In Scotland the price of heavy machinery cast-iron scrap is firm at 55s. to 56s. 3d., with ordinary cast iron, suitable for foundries and in pieces not exceeding 1 cwt., at 52s. 6d. per ton.

Metals

Copper.—The copper market has not yet recovered fully from the reaction which followed the premature rise in prices of a fortnight ago. Although the outlook is still rather uncertain, quotations have been rather firmer during the last day or two. Rumours continue to circulate regarding the taking of international action to curtail output, but nothing definite has as yet emerged.

Daily market prices:—

Cash.—Thursday, £27 5s. to £27 6s. 3d.; Friday, £27 5s. to £27 6s. 3d.; Monday, £26 18s. 9d. to £27; Tuesday, £27 10s. to £27 12s. 6d.; Wednesday, £27 11s. 3d. to £27 12s. 6d.

Three Months. — Thursday, £27 11s. 3d. to £27 12s 6d.; Friday, £27 11s. 3d. to £27 12s. 6d.; Monday, £27 5s. to £27 6s. 3d.; Tuesday, £27 16s. 3d. to £27 17s. 6d.; Wednesday, £27 17s. 6d. to £27 18s. 9d.

Tin.—According to the October bulletin of the International Tin Research and Development Council, the world's "apparent" consumption of tin for the twelve months ended August, 1934, was 121,400 tons, as compared with 117,000 tons in the preceding twelve months. The bulletin contains a number of charts representing moving averages of tin consumption, which indicate that world consumption has at present a downward tendency attributable to the United States, Germany and France, the trend in nearly all other countries being upwards or approximately on the same level. World consumption for the month of August, 1934, is given as 10,048 tons, as compared with 9,802 tons for July, 1934, and with 13,514 tons for August, 1933.

The value of tin on the London market has remained fairly stable, as the result of the strong support given by the "pool." By all accounts, there has not been much new buying by consumers during the past week or two.

Price fluctuations:—

Cash.—Thursday, £229 2s. 6d. to £229 5s.; Friday, £229 to £229 2s. 6d.; Monday, £228 17s. 6d. to £229; Tuesday, £228 12s. 6d. to £228 15s.; Wednesday, £228 7s. 6d. to £228 10s.

Three Months. — Thursday, £228 10s. to £228 12s. 6d.; Friday, £228 10s. to £228 12s. 6d.; Monday, £228 10s. to £228 12s. 6d.; Tuesday, £228 10s. to £228 12s. 6d.; Wednesday, £228 10s. to £228 12s. 6d.

Spelter.—"There is no evidence of real weakness; support has certainly been in a measure withdrawn, but offerings are not heavy, and with a continuance of the scarcity of Empire metal, high prices are paid for duty-free metal for prompt delivery. The situation in Germany is still a subduing influence," report Messrs. Rudolf Wolff & Company.

Day-to-day quotations:—

Ordinary. — Thursday, £12 11s. 3d.; Friday, £12 6s. 3d.; Monday, £12 6s. 3d.; Tuesday, £12 7s. 6d.; Wednesday, £12 5s.

Lead.—Quotations for this metal last week followed a downward trend, in accordance with the general weakness in base metals, but have since been slightly firmer.

Price fluctuations have been as follow:—

Soft Foreign (Prompt).—Thursday, £10 10s.; Friday, £10 6s. 3d.; Monday, £10 6s. 3d.; Tuesday, £10 6s. 3d.; Wednesday, £10 5s.

Contracts Open

Crundale, November 10.—Supplying and laying of 3-in. and 2-in. cast-iron mains, with valves, etc., for the Haverfordwest Rural District Council. Mr. D. W. Rees, National Provincial Bank Chambers, Ammanford. (Fee £2 2s., returnable.)

Manchester, November 10.—Cast-iron manhole covers, valve casings, etc.; cast-iron pipes, special castings, for the Waterworks Committee. The Chief Engineer, Waterworks Offices, Town Hall, Manchester, 2.

Margate, November 12.—8,400 yds. 15-in. dia. bitumen-lined steel pipes, or cast-iron pipes, and about 2,550 yds. 15-in., 200 yds. 10-in. and 130 yds. 9-in. dia. asbestos cement pressure pipes, for the Town Council. The Borough Engineer, 40, Grosvenor Place, Margate. (Fee £5 5s., returnable.)

Morecambe.—Cast-iron gas mains and specials for 12 months, for the Town Council. The Borough Gas Engineer, Moss Lane, Morecambe.

Kingston, November 21.—Supplying and fixing a weighbridge, capacity 20 tons, for the Town Council. The Borough Surveyor. (Fee £1 1s., returnable.)

Technical Training

In a Paper entitled "The Training of the Technician" presented to the Association of Engineering and Shipbuilding Draughtsmen, Prof. A. L. Mellanby, of the Royal Technical College, Glasgow, said that it had been felt by some that the present courses of study might not be the best of which the district was capable. A report had been drawn up in which the progress of the students attending the courses was recorded, and an attempt had been made to obtain some idea of the number of those engaged in engineering works to whom the highest type of technical training was necessary. The figures had been closely analysed. It appeared, as a rough estimate, that in the average modern works the staff should amount to about 10 per cent. of the total employed. Prof. Mellanby submitted that for an efficient industry the greater proportion of those on the engineering staff should receive the highest technical training possible. Some people said that the universities and technical colleges were turning out too many technical men, but an analysis showed that the whole certificated output of day and evening classes was insufficient to meet the normal wastage of the men engaged in that branch of industry. If reform was necessary in education, a change was also needed in the attitude of employers to the young men in the industry. With a few exceptions, employers did not encourage new ideas unless they came from abroad. Many of our best engineers were merely the licensees of foreign builders, but he had noticed that almost invariably when a foreign idea was taken up by British engineers it was vastly improved. Given reasonable encouragement the British engineer could beat the foreign technician every time, and it seemed to him that the employers in this country should co-operate more with, and more fully appreciate the value of, the young men in the industry. Prof. Mellanby suggested that a better appeal to the average youth could be made by introducing at an early stage some idea of engineering economics, methods of production and properties of materials. The essentials of mathematics, physics and mechanics might be presented in a manner more likely to interest the average young engineer than at present.

XUM

GENUINE COLD BLAST PIG IRON

In addition to their renowned chilling properties, and their resistance to wear and to growth under heat, our COLD BLAST PIG IRONS are noted for their

Our Cold Blast Pig Irons are All-mine Blast Furnace Products.

GREAT STRENGTH *and* TOUGHNESS

If you wish to improve the quality of your engineering castings—to make them sounder, stronger, more durable, try COLD BLAST PIG IRON in your mixture. It is the easiest way. It requires no change in your ordinary foundry practice. The initial cost may be a little more, but it will be a saving to you in the end, if it helps you to turn out higher quality finished castings and to cut down your loss from wasters and rejected castings.

TRY THIS BEST KIND OF ALL BLAST FURNACE IRONS

Write to any of us for particulars.

THE EARL OF DUDLEY'S ROUND OAK WORKS, LTD.,
BRIERLEY HILL, STAFFS.
Brand: "DUD·L.N.F'ces·DUD"

M. & W. GRAZEBROOK, LIMITED,
DUDLEY, WORCS.
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THE LOW MOOR IRON CO., LTD.,
NEW WORKS, LOW MOOR, BRADFORD - YORKSHIRE.
Brand: "LOWMOOR C.B."

MAKERS OF GENUINE COLD BLAST PIG IRON

RAW MATERIALS—PRICE LIST

(Wednesday, November 7, 1934)

COPPER

	£	s.	d.
Standard cash	27	11	3
Three months	27	17	6
Electrolytic	30	10	0
Tough	29	5	0
Best selected	29	15	0
Sheets	58	0	0
India	40	5	0
Wire bars	30	15	0
Ingot bars	30	15	0
H.C. wire rods	33	5	0
Off. av. cash, October	26	15	9 21/40
Do., 3 mths., October	27	1	8 15/16
Do., Sttlmnt., October	26	15	11 17/20
Do., Electro, October	29	17	6
Do., B.S., October	29	15	10
Do., wire bars, October	30	5	5 5/20
Solid drawn tubes			9½d.
Brazed tubes			9½d.
Wire			6d.

BRASS

Solid drawn tubes	8¾d.
Brazed tubes	10¼d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	4¼d.
Sheets to 10 w.g.	7d.
Wire	7¼d.
Rolled metal	6½d.
Yellow metal rods	4¼d.
Do. 4 × 4 Squares	5¼d.
Do. 4 × 3 Sheets	5½d.

TIN

	£	s.	d.
Standard cash	228	7	6
Three months	228	10	0
English	228	10	0
Bars	230	7	6
Straits	228	15	0
Australian (nom.)	—		
Eastern	229	5	0
Banca	229	12	6
Off. av. cash, October	230	13	7 15/20
Do., 3 mths., October	228	16	9 12/20
Do., Sttlmt., October	230	13	8 4/20

SPELTER

	£	s.	d.
Ordinary	12	5	0
Remelted	13	5	0
Hard	10	10	0
Electro 99.9	14	17	6
English	13	12	6
India	12	0	0
Zinc dust	17	0	0
Zinc ashes	3	0	0
Off. aver., October	12	5	8 13/20
Aver. spot, October	12	4	4 4/20

LEAD

	£	s.	d.
Soft foreign ppt.	10	5	0
Empire (nom.)	11	5	0
English	12	10	0
Off. average, October	10	9	1 13/20
Average spot, October	10	7	2 8/20

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	10	0
Do., V.M. ex whse.	22	15	0
Rods	27	0	0

ANTIMONY

	£	s.	d.		£	s.	d.
English	49	0	0	to	52	10	0
Chinese, ex-whse.					50	0	0
Crude					—		

QUICKSILVER

Quicksilver	11	2	6	to	11	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£13 0 0
75%	£18 7 6
Ferro-vanadium —	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	5/6 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	3/– lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	£29 15 0
4/6% car.	£23 0 0
6/8% car.	£21 12 6
8/10% car.	£21 12 6
Ferro-chrome—	
Max. 2% car.	£36 0 0
Max. 1% car.	£38 15 0
Max. 0.70% car.	£42 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 5/16 in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

South Wales—	£	s.	d.		£	s.	d.
Heavy steel	2	15	0	to	2	16	0
Bundled shrngs.					2	7	6
Mixed iron and steel	2	10	0	to	2	12	6
Heavy cast iron	2	8	6	to	2	10	0
Good machinery	2	12	6	to	2	15	0
Cleveland—							
Heavy steel					2	10	0
Steel turnings					1	15	0
Cast-iron borings					1	5	0
Heavy forge					2	10	0
W.I. piling scrap					2	5	0
Cast-iron scrap	2	13	6	to	2	16	0
Midlands—							
Light cast-iron scrap					2	7	6
Heavy wrought iron	2	17	6	to	3	0	0
Steel turnings, f.o.r.					1	12	6
Scotland—							
Heavy steel	2	10	0	to	2	11	3
Ordinary cast iron					2	12	6
Engineers' turnings					1	19	6
Cast-iron borings					1	17	6
Wrought-iron piling					2	10	0
Heavy machinery					2	15	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	24	0	0
Brass	16	10	0
Lead (less usual draft)	10	0	0
Tea lead	7	0	0
Zinc	9	0	0
New aluminium cuttings	66	0	0
Braziery copper	19	0	0
Gunmetal	23	0	0
Hollow pewter	150	0	0
Shaped black pewter	112	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/–
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	69/–
Hematite M/Nos.	68/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/–
,, No. 3 fdry.	71/–
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/–
,, fdry. No. 3	71/–
,, fdry. No. 1	74/–
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/–
Hem. M/Nos. d d	71/–
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	81/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/–
Staffs fdry. No. 3	74/–
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/–
Dalzell, No. 3 (special)	102/6 to 105/–
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	12	6	to	9	15	0
Nut and bolt iron	7	10	0	to	8	0	0
Hoops	10	10	0	and up.			
Marked bars (Staffs) f.o.t.				12	0	0	
Gas strip	10	10	0	and up.			
Bolts and nuts, ¾ in. × 4 in.				14	0	0	
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	0	0	to	8	10	0
Chequer plts.				10	7	6	
Angles				8	7	6	
Tees				9	7	6	
Joists				8	15	0	
Rounds and squares, 3 in. to 5½ in.				9	7	6	
Rounds under 3 in. to ⅜ in. (Untested)				8	12	0	
Flats—8 in. wide and over				8	12	6	
,, under 8 in. and over 5 in.				8	17	6	
Rails, heavy	8	5	0	to	8	10	0
Fishplates	12	5	0	to	12	10	0
Hoops (Staffs)				9	7	0	
Black sheets, 24g. (4-t. lots)				10	10	0	
Galv. cor. shts. (,,)				13	0	0	
Galv. flat shts. (,,)				13	10	0	
Galv. fencing wire, 8g. plain				14	10	0	
Billets, soft	5	10	0	and up.			
Billets, hard	6	17	6	to	7	2	6
Sheet bars	5	2	6	to	5	10	0
Tin bars	5	2	6	to	5	7	6

PHOSPHOR BRONZE

	Per lb. basis
Strip	9d.
Sheet to 10 w.g.	10d.
Wire	11½d.
Rods	10d.
Tubes	13d.
Castings	10⅝d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	18.00
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	27.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.80
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/– to 32/6
,, furnace	19/– to 21/–
Durham foundry	20/– to 25/–
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		18/2 to 18/7½
,,	28×20	,,	36/4 to 37/3
,,	20×10	,,	26/–
,,	18¾×14	,,	18/9
C.W.	20×14	,,	15/9
,,	28×20	,,	34/–
,,	20×10	,,	23/–
,,	18¾×14	,,	16/–

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0	to	£7	0	0
Bars-hammered, basis	£16	0	0	to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to	£16	0	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£30	0	0	to	£31	0	0
Faggot steel	£18	0	0	to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0	to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
Nov. 1 ..	27	5	0	dec.	13/9
„ 2 ..	27	5	0	No	change
„ 5 ..	26	18	9	dec.	6/3
„ 6 ..	27	10	0	inc.	11/3
„ 7 ..	27	11	3	„	1/3

Electrolytic Copper

		£	s.	d.	
Nov. 1 ..	30	0	0	dec.	10/-
„ 2 ..	30	0	0	No	change
„ 5 ..	29	10	0	dec.	10/-
„ 6 ..	30	10	0	inc.	20/-
„ 7 ..	30	10	0	No	change

Standard Tin (cash)

		£	s.	d.		
Nov. 1 ..	229	2	6	dec.	5/-
„ 2 ..	229	0	0	„	2/6
„ 5 ..	228	17	6	„	2/6
„ 6 ..	228	12	6	„	5/-
„ 7 ..	228	7	6	„	5/-

Tin (English ingots)

		£	s.	d.		
Nov. 1 ..	229	5	0	dec.	5/-
„ 2 ..	229	0	0	„	5/-
„ 5 ..	229	0	0	No	change
„ 6 ..	228	15	0	dec.	5/-
„ 7 ..	228	10	0	„	5/-

Spelter (ordinary)

		£	s.	d.		
Nov. 1 ..	12	11	3	dec.	2/6
„ 2 ..	12	6	3	„	5/-
„ 5 ..	12	6	3	No	change
„ 6 ..	12	7	6	inc.	1/3
„ 7 ..	12	5	0	dec.	2/6

Spelter (Electro, 99.9 per cent.)

		£	s.	d.		
Nov. 1 ..	15	3	9	No	change
„ 2 ..	14	18	9	dec.	5/-
„ 5 ..	14	18	9	No	change
„ 6 ..	15	0	0	inc.	1/3
„ 7 ..	14	17	6	dec.	2/6

Zinc Sheets (English)

		£	s.	d.	
Nov. 1 ..	23	10	0	No	change
„ 2 ..	23	10	0	„	„
„ 5 ..	23	10	0	„	„
„ 6 ..	23	10	0	„	„
„ 7 ..	23	10	0	„	„

Lead (English)

		£	s.	d.	
Nov. 1 ..	12	10	0	dec.	5/-
„ 2 ..	12	10	0	No	change
„ 5 ..	12	10	0	„	„
„ 6 .	12	10	0	„	„
„ 7 ..	12	10	0	„	„

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1902	0 16 9	0 15 0	0 15 6	0 15 0	0 15 0	0 15 3	0 15 3	0 15 3	0 15 6	0 16 0	0 16 6	0 16 0	0 15 5
1903	0 15 9	0 16 0	0 16 3	0 16 9	0 16 6	0 16 3	0 16 0	0 15 9	0 15 6	0 15 0	0 14 6	0 14 0	0 15 8½
1904	0 13 9	0 13 9	0 13 3	0 14 3	0 14 6	0 14 3	0 14 3	0 14 3	0 14 3	0 14 0	0 14 0	0 14 6	0 14 1½
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	*	*	*	*	*	*	*	1 5 0	1 1 1½ ‖
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 8
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 6½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2½
1931	0 17 0	0 16 7½	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 16 6	0 16 0½
1932	0 17 0	0 16 11½	0 16 5½	0 15 9	0 15 7½	0 15 6	0 15 6	0 14 9½	0 14 6½	0 14 6	0 14 6	0 15 4	0 15 6½
1933	0 16 0½	0 15 11½	0 15 6½	0 15 6	0 15 6	0 15 6	0 15 6	0 15 8½	0 16 1½	0 17 0	0 17 6	0 18 0	0 16 1½
1934	0 19 1½	1 0 6	1 0 2	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	—	—	—

* Strike period. ‖ Five months.

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